PETROLEUM

IN

SOUTHERN CALIFORNIA

ISSUED BY

CALIFORNIA STATE MINING BUREAU

W. BURLING HAMILTON, State Mineralogist

1913

Presented to the
LIBRARY *of the*
UNIVERSITY OF TORONTO
by

ONTARIO
DEPARTMENT
OF
MINES.

RECEIVED
MAY 9 1913

BULLETIN 63.

PETROLEUM

IN

SOUTHERN CALIFORNIA

1913

COMPILED BY
PAUL W. PRUTZMAN

ISSUED BY
CALIFORNIA STATE MINING BUREAU

F. McN. HAMILTON
State Mineralogist

FRIEND WM. RICHARDSON, SUPERINTENDENT OF STATE PRINTING
SACRAMENTO, CALIFORNIA
1913

TN
24
C3A4
no. 59

CALIFORNIA STATE MINING BUREAU.

FERRY BUILDING, SAN FRANCISCO.

F. McN. HAMILTON ---------- State Mineralogist.

BOARD OF TRUSTEES.

CALVERT WILSON, Los Angeles ---------- President

HENRY E. MONROE, San Francisco ---------- Secretary

E. C. HUTCHINSON, San Francisco

JOHN G. FLETCHER, Oakland.

LETTER OF TRANSMITTAL.

To his Excellency, the Hon. HIRAM W. JOHNSON, *Governor of the State of California and the Honorable Board of Trustees of the State Mining Bureau.*

GENTLEMEN:

I herewith submit Bulletin 63, "Petroleum in Southern California." The material of this publication has been gathered and compiled by Paul W. Prutzman. Although there has been considerable delay in its completion, I think it will be found a valuable publication to the industry.

Respectfully yours,

F. McN. HAMILTON,
State Mineralogist.

February 17, 1913.

Photo by West Coast Art Co.

Fullerton Oil Field. Los Angeles and Orange Counties.

Oil Field. Los Angeles and Orange Counties.

TABLE OF CONTENTS.

			Page.
Chapter	I.	Descriptive, Topography and Climate	1
		Oil Developments	4
Chapter	II.	Methods of Oil Analysis	8
		Source and Classification of Analyses	12
		Gravity Readings	13
		Sulfur Determinations	13
		Distillation Tests	14
Chapter	III.	Pirie, Sulphur Mountain and Ojai Wells	21
		Ventura County, Topography and Climate	21
		Subdivisions of County	23
		Wells West of Ventura River	26
		Pirie Wells	27
		Wells in Ventura River Valley	33
		Sulphur Mountain Wells	34
		Lyon Cañon Wells	40
		Ojai Wells	41
		Analyses of Ojai Oils	46
Chapter	IV.	Ex-Mission, Silverthread and Empire Wells	50
		Ex-Mission Wells	51
		Analyses of Ex-Mission Oils	57
		Silverthread or Sisar Wells	74
		Analyses of Silverthread Oils	80
		O'Hara or Paula Wells	85
		Scattering Wells in Santa Paula Creek	86
		Empire or Loma Wells	88
		Analyses of Paula Oils	89
Chapter	V.	Sespe and Hopper Cañon Wells	91
		Structure of Sespe Country	91
		Big Sespe Wells	92
		Little Sespe—Tar Creek Group	95
		Tabulation of Tar Creek Wells	98
		Wells North of Tar Creek	101
		Wells East and South of Tar Creek	101
		Analyses of Sespe-Tar Creek Oils	104
		Hopper Cañon Wells	117
		Analyses Hopper Cañon Oils	119
Chapter	VI.	Bardsdale Wells	123
		Analyses of Bardsdale Oils	127
Chapter	VII.	Modelo, Torrey, Eureka and Tapo Wells	133
		Modelo and Temescal Wells	133
		Eureka Wells	137
		Tapo Wells	138
		Torrey Wells	140
		Simi Wells	141
		Analyses of Modelo, Torrey and Tapo Oils	142
Chapter	VIII.	Calleguas Wells	152
Chapter	IX.	Summary of Operations in Ventura County	153
Chapter	X.	Los Angeles County	156
		Newhall Field	156
		Castaic Wells	158
		Pico Wells	159
		Tabulation of Pico Wells	160
		DeWitt Cañon Wells	166
		Towsley Cañon Wells	167
		Wiley Cañon Wells	168
		Rice and East Cañon Wells	169
		Leaming, Elsmere and Newhall Cañon Wells	170
		Wells on South Slope of San Fernando Mountains	176
		Placerita Cañon Wells	177
		Wells North of Soledad Cañon	178
		Tujunga Wells	179

			Page.
Chapter X.—Continued.			
		Recapitulation of Newhall Operations	181
		Analyses of Newhall Oils	182
Chapter	XI.	Los Angeles City Field	195
		East Los Angeles Wells	197
		East Field	198
		Central or Old Field	201
		West Field	203
		Western Avenue Wells	205
		Analyses of City Oils	206
Chapter	XII.	Salt Lake or Sherman Field	216
		Development and Limits of Field	226
		Statistics of Salt Lake Field	227
		Wells South of Wilshire Boulevard	228
		Wells in Beverly Hills	233
		Analyses of Salt Lake Oils	234
Chapter	XIII.	Puente Hills Group	247
		Whittier Field	248
		Recapitulation of Whittier Operations	259
		Analyses of Whittier Oils	261
Chapter	XIV.	Coyote and Anaheim Wells	274
		Analyses of Coyote and Anaheim Oils	278
Chapter	XV.	Puente Wells	280
		Analyses of Puente Oils	286
Chapter	XVI.	Fullerton Field	294
		Brea Cañon Wells	296
		Olinda Wells	299
		Analyses of Brea-Cañon and Fullerton Oils	308
Chapter	XVII.	Scattering Wells in Los Angeles, Orange and San Bernardino Counties	326
		Lancaster Wells	326
		Calabasas and Redondo Wells	327
		San Pedro Wells	328
		Long Beach Wells	329
		Wells north of Los Angeles City	329
		Wells south of Los Angeles City	331
		Compton Wells	332
		Rapetto Hills Wells	333
		Chino Valley Wells	335
		Santa Ana and Newport Wells	335
		Orange County Wells	334
		Laguna Beach and Capistrano Wells	337
		San Bernardino County, Chino Wells	337
Chapter	XVIII.	Santa Barbara County	339
		Casmalia Group	341
		Santa Ynez Group	343
		Lompoc or Purissima Group	345
		Analysis Lompoc Oil	351
Chapter	XIX.	Santa Maria or Old Field	352
		Productiveness of Santa Maria Wells	366
		Analyses of Santa Maria Oils	377
Chapter	XX.	Cat Cañon Wells	379
		Operating Conditions in Cat Cañon	387
		Extent of Cat Cañon Field	389
		Analyses of Cat Cañon Oils	391
Chapter	XXI.	Santa Barbara Coast	396
		Indications of Oil on Coast	397
		Wells between Naples and Santa Barbara	399
		Wells between Santa Barbara and Rincon Creek	401
		Probable structure of the Coast Strip	404
		Wells in Rincon Creek	406
		Wells in Santa Ynez Foothills	407
		Summerland Wells	408
		Analyses Summerland Oils	413
		Analyses Empire Oils	416

ILLUSTRATIONS.

PAGE.
Fullerton Oil Field, Los Angeles and Orange Counties ---- Frontispiece
Pirie Ranch, Ventura County ---- 20-21
City of Ventura ---- 20-21
Ventura River, looking north ---- 24-25
Bituminized shale and sandstone, Hall Cañon, Ventura County ---- 24-25
Showing north slope of Pirie anticline, west side Ventura River, Sturgis ranch ---- 40-41
Exposure of bituminized shales, Ventura County ---- 40-41
Looking north in Little Sespe ---- 90-91
Looking north on Little Sespe Ridge ---- 90-91
Sespe, looking northeast on Four Forks Claim ---- 98-99
Upper Sespe, Ventura County ---- 98-99
Mouth of Temescal Creek, north of Piru, Ventura County ---- 132-133
Vertical strata at base of Torrey formation, Eureka Cañon, Ventura County ---- 136-137
Contorted strata, Eureka Cañon, Ventura County ---- 136-137
Looking up Eureka Cañon toward Tapo Wells ---- 140-141
Torrey Cañon, Ventura County ---- 140-141
Looking up Castaic Cañon from above New Castaic location ---- 158-159
Anticlinal fold in Charley Cañon, Los Angeles County ---- 158-159
Pico Cañon, Newhall, Los Angeles County ---- 170-171
Wells in Newhall Cañon, Newhall, Los Angeles County ---- 170-171
Soledad Cañon, Los Angeles County ---- 200-201
Portion of East Field, Los Angeles City ---- 200-201
La Brea Lease, Salt Lake Oil Field ---- 216-217
Pitch Lake, Rancho La Brea, Los Angeles County ---- 216-217
Town of Whittier, from Commonwealth Lease ---- 248-249
North-dipping strata, north slope of Whittier main anticline ---- 248-249
Whittier Crude and Home Wells, Whittier Oil Field, Los Angeles County ---- 252-253
Central No. 49, on apex of Whittier anticline ---- 252-253
Looking southeast from Zaca Pass over Zaca Valley and Santa Ynez Mountains, Santa Barbara County ---- 344-345
Asphalt refineries at Hadley, San Luis Obispo County ---- 344-345
Northeast from Folsom Lease, Santa Maria ---- 352-353
Radium, Brookshire and Pinal Leases ---- 352-353
Dome, Hobbs (Union) and Rice Ranch Leases, Santa Maria Oil Field ---- 356-357
Hills south of Zaca Valley, Santa Barbara County ---- 356-357
Fox and Hobbs Leases, Union Oil Company, San Maria Oil Field ---- 358-359
Looking east on Newlove Tract, Santa Maria ---- 358-359
Cat Cañon Oil Field, Santa Barbara County ---- 378-379
An oil reservoir, Cat Cañon Field ---- 384-385
Palmer and Dome Wells, Cat Cañon ---- 384-385
Wells on Summerland Beach, Santa Barbara County ---- 408-409
Summerland Wells, from K. T. & O. Wharf ---- 408-409

MAPS.

In pocket at back of book.

ERRATUM.

Page 10, line two should read, "out in practice, and to learn the difficulties, if any, lying in the way"

Page 105, No. 5469, in commercial analysis, per cent asphalt should be 40.7.

Page 137, line 7, date should be 1910 instead of 1900.

Page 182, No. 4481 should be No. 5484.

Page 184, No. 5484 should be No. 7444. †Analysis by H. N. Cooper.

Page 186, No. 7444 should be No. 4412. †Analysis by J. P. P.

Page 191, No. 4412 should be No. 2462.

Page 192, No. 2462 should be No. 5482.

Pages 217 to 245, title at top of page should read Field instead of Island.

Page 220, Fig. 28, Cross Section Salt Lake Field.

Page 221, all after the word "southwest" in lines 18 and 19 should be omitted.

Page 249, Fig. 29, Cross Section Whittier Oil Field.

Page 278, No. 6468, in commercial analysis, per cent kerosene should be 7.0, not 13.6.

THE STATE OF CALIFORNIA.

CHAPTER I.

DESCRIPTIVE.

The State of California.

The great State of California divides itself naturally into five areas, differing materially in geology, climate, and resources. These divisions may be described as—the eastern Desert Region, the great Central Valley, the Coast Valley section, the Coast country proper, and Southern California, or California south of the Tehachapi. While the latter alone forms the proper subject of the present report, certain exigencies of the case require the inclusion of portions of two other divisions, and a word as to the principal features of each area may be permissible.

The Desert Region.

The most easterly division is that arid region lying east of the Sierra Nevada and the San Bernardino mountains, and extending a westerly arm almost to the Pacific Ocean, between the Tehachapi and San Gabriel ranges. This division is characterized geologically by the evidences, in almost every part, of rather late volcanic and of lacustrine conditions. Topographically it is a high table-land, of sandy plains, with scattered and very prominent mountain ranges, while in point of climate it is distinguished by extreme heat and desiccation. The application of the term "desert" to this region is, in large part, due to the lack of water, as, where irrigation is possible, the soil, light though it may appear, proves highly productive.

Petroleum has been sought in several parts of this desert area, but so far without success.

The Great Central Valley.

Lying between the Sierra Nevada and the Coast Range, and extending from the Tehachapis almost, or quite, to the Oregon line, is the central or interior valley, made up of the drainage basins of the Sacramento and San Joaquin rivers, which unite as they enter San Francisco Bay. This great basin, averaging perhaps a hundred miles in width, and upwards of four hundred miles long, is characterized geologically in consisting, in its bed, of late marine sediments and river silt, and on its flanks of marine sediments mainly of Tertiary age, though abutting on a region of great lava flows on its northeastern extremity. Topographically it is strongly characterized by its perfect basin form, the entire width of the valley, from its northern to its southern termination, sloping gently to one point, and being free from

any interruption by hills or mountains, excepting, of course, where it merges into the mountains which fix its bounds. The climate is also characteristic, being hot and perfectly dry in summer, mild in winter, with a rainfall varying from heavy at the northern end to very light at the southern. Having a highly fertile soil throughout, and an ample supply of water on its eastern side, this and the central portion of the valley are extensively irrigated and are uniformly and highly productive. The western mountains being waterless on the valley side, such of the foot plain of these mountains as is above the level of irrigation from the east, though equally fertile, is partly uncultivated, particularly in the southern portion, where the winter rains are deficient.

Oil fields of the state, located in the central valley, are not described in the present report. These fields are Coalinga, Devils Den, Lost Hills, Belridge, McKittrick, Midway, Buena Vista, Elk Hills and Maricopa or Sunset, lying in a long and almost continuous strip along the southern portion of the hills to the west of the valley, San Emidio at the southern end, and Kern River, in the foothills of the Sierra, to the east of the valley and directly opposite the west side fields.

Coast Valley Division.

Lying between the Coast Range proper and a number of minor ranges paralleling this range and the ocean, are four large and a number of smaller valleys, all having a general direction parallel to the central valley and to the Coast. Eel River Valley, the most northern, drains to the Pacific at Eureka. Geologically this valley exhibits marine sedimentary formations of moderate age, though mainly somewhat older than those of the central valley; topographically it consists of a delta basin of semicircular form, with narrow valleys branching north and south, surrounded and separated by rough, wooded hills of moderate height. The soil of this valley is of unparalleled fertility; the climate: in winter, very mild, with excessive rainfall; in summer, dry, mild, and invigorating.

Petroleum has been known to exist in the southern portion of this valley since the first settlement of the State, but, though many wells have been drilled, and some oil obtained, no paying production has yet been had. Prospecting continues at intervals, stimulated by the easy drilling conditions obtaining here, and the exceptionally high quality of the oil.

The Sonoma and Santa Clara valleys drain south and north into San Francisco Bay. They closely resemble the corresponding portions of the central valley, but, owing to proximity to the coast, have a rather more equable climate and greater rainfall. The Salinas Valley, draining to the Pacific near Watsonville, is a *replica* of the Santa Clara Valley, but on a somewhat greater scale, and with a rather warmer climate.

Petroleum has been sought at various points in the Sonoma Valley, but without much encouragement to future operations. In the Santa Clara Valley a small deposit of light oil was early discovered, and worked out, and though small quantities have been found at other points on the west side of the valley, no production is now had at any part of this valley. Toward the southern end of the Salinas Valley, both west and east, numerous attempts to obtain oil have been made, and oil in small quantities has been found in a number of places, but no production has been had, though scattered prospecting still continues. At Sargents, in the hills dividing the Salinas from the Santa Clara Valley, a small pool of heavy oil was opened some years since, but no success has been met in the effort to extend this area.

The Santa Maria Valley, draining due west to the Pacific Ocean at Guadalupe, exhibits conditions similar to those of the Salinas Valley. The soil, though light, is extremely productive, and the climate very mild, both winter and summer. The Santa Maria Valley, and the hills immediately south, are the seat of extensive and important oil deposits, which will be fully described in the present report.

The lower Santa Clara Valley, or valley of the Santa Clara River, draining to the ocean at Ventura, is very similar to the Santa Maria Valley. This is also an important producing region, and will be described fully hereafter. Many smaller valleys, all of very limited extent, occur in the hill ranges on each side, and have characteristics generally similar to those of the main valleys adjacent.

The Coast.

The Coast section proper is that portion of the State, north of Santa Barbara, lying immediately adjacent to the Pacific Ocean. Geologically it consists of late marine sediments, usually more or less disturbed; topographically it is a rather narrow strip of rolling hills, too steep for agriculture in the main, and given over to grazing. As between Eureka, Point Arena, San Francisco, and Monterey the coast is quite devoid of harbors, and is backed by rough hills, much of this strip is quite inaccessible, and is but thinly settled. The climate, winter and summer, is extremely mild, and the seasons may hardly be distinguished other than by the rainfall, which in summer gives place to heavy fogs.

Petroleum has been sought at a number of points along the coast, though but two have yielded any production whatever, and this not of commercial importance.

Southern California.

The county of Ventura consists, in its northern portion, of a group of high and rugged mountains, from which radiate a number of important ranges. To the northwest extend the Mt. Diablo and Coast ranges, having the San Joaquin Valley on their east, the Cuyama and Clarissa valleys between, and the coast to the west.

Westward extends the Santa Ynez Range, forming the backbone of Santa Barbara County, and having the Santa Maria Valley to the north, and the ocean to the south and at its west end.

The Tehachapi leaves this group in a northeasterly direction, swinging to the north to join the Sierra Nevada. The southern end of the San Joaquin Valley lies north of this range, and the Mojave Desert, the most westerly arm of the great desert region, forms a high plateau to the south.

The San Rafael Mountains are the most southerly range of this cluster, and continue to the eastward under the names of Tujunga, San Gabriel, and San Bernardino, all constituting a continuous range and formation, having to the north the Mojave Desert, and to the south Southern California proper. At Mount San Bernardino, in the western portion of the county of that name, this range turns to the southeast, and continues in that direction, parallel to the coast, to the Mexican border, under the names San Jacinto and San Ysidro mountains. Southern California lies to the west of this range, or system of ranges, and the southern portion of the great desert to the east.

Southern California, then, consists of a parallelogram, with its upper and lower bounds lying east and west, and its longer sides very nearly northwest by southeast. The length of this figure is upwards of one hundred and fifty miles, the average width about fifty.

The climate of this area is consistently mild and dry. The limited rainfall takes place entirely in winter, and is generally insufficient to the needs of agriculture. Irrigation is, therefore, extensively practiced, there being an abundance of water for this purpose. In the more level portions, the soil is exceedingly productive, and is largely devoted to the raising of fruits, nuts, and vegetables. The hilly region south of the Santa Ana River is mainly given to grazing.

Oil Developments.

The northern portion of this quadrangle consists of the low foothills of the San Gabriel Range, and in these foothills are situated the city of Los Angeles, and the productive oil fields of Salt Lake, Los Angeles, Whittier, Puente, and Fullerton, lying along an east and west line passing through the city. The Newhall and Ventura deposits follow a line of similar direction, but farther to the north and west, while the Summerland field, and the seepages along the coast from Naples to Carpinteria follow a third parallel line. This mode of occurrence may be fortuitous, but is sometimes held to indicate a relation with the peculiar structure of this country. It will be noted in this connection that all these deposits occur on the south side of the main mountain ranges, while those of the Santa Maria-Lompoc group, which follow a parallel line, lie on both sides of a low range of pronounced anticlinal structure.

South of Los Angeles is a plain of slight elevation, formed by, or determining, the confluence of the Los Angeles, San Gabriel, and Santa Ana rivers. This plain, extending from Santa Monica to Newport, and from San Pedro to the mountains east of Fullerton, is more or less interrupted by low hills lying parallel to the coast, and at some points, as at San Pedro and Newport, immediately adjacent thereto. Seepages and asphalt deposits occur in these hills, close to the coast, and lignitic coal and some indications of petroleum in the Santa Ana Mountains, but no production has been had, in spite of considerable prospecting. South of the Santa Ana River the country consists entirely of low hills with narrow intervening valleys, in which no direct indications of oil have been reported. Prospecting here has been confined to the coast north of San Diego, and, so far as can be learned, has been entirely fruitless.

The oil fields of Southern California are distinguished from each other, as well as from the fields farther north, by certain peculiarities of structure, as also in character and quantity of production. In particular, the uniformity of some of the northern fields is entirely lacking, the only fields in this part of the State showing any degree of uniformity being those of Los Angeles City, where all the wells are, and were, very small producers. There is no doubt, however, that this may be in part ascribed to excessive crowding, and as this field shows a marked resemblance to Kern River in depth, character of oil, and formation, there is some reason to think that if it had been drilled in the manner practiced in the north the per well production would have at least approached that of Kern River.

Both the Los Angeles City and Salt Lake fields are very narrow strips, hardly more than a quarter of a mile in width at any point, but while the city field approximated the same yield and character of oil at all points, both these factors are extremely variable at Salt Lake. The oil of this latter field ranges from a light tar to a very gassy and volatile oil of some 25° gravity, and is peculiar among the oils of this State by its unusually high percentage of sulfur, and by a much greater volatility than the gravity would indicate.

The Whittier field, which is separated from Los Angeles by but a narrow interval, is somewhat similar in formation, being a rather narrow strip dipping the narrow way, but differs considerably in the local conditions, the characteristic rocks of the Los Angeles field being soft shales and clays, while conglomerates and other harder materials predominate at Whittier. In the latter field also the production of individual wells, while always small as judged by the usual standards in this State, varies considerably from well to well, as does also the character of the oil. This, however, varies normally; that is, heavy oils are found close to the outcrops and faults, while lighter oils are developed farther down the dip. The character of Whittier oil, from the chemical standpoint,

is quite uniform, regardless of gravity, and is sharply distinguished from that of Los Angeles and Salt Lake oil by the much smaller percentage of sulfur, which approaches that of the Midway oils.

The Puente group, which is closely adjacent to the Whittier wells, resembles the latter in quality of oil produced, and in small individual production, which, however, is more uniform and at a more regular depth. The oil of Puente is also somewhat lighter than even the lightest at Whittier, but resembles it in chemical makeup and refining value. Immediately south, however, of the Puente wells, is the Brea Cañon group, which produce a very different oil, and under different conditions. These oils are much heavier; the formation is a monocline of very moderate dip, and individual production is much larger, reaching very substantial figures in some cases.

Irregularities of every kind are perhaps more marked in the Fullerton or Olinda fields than in any other single group of wells in the State. Not only do the depth of wells, productiveness, and gravity vary widely within a very limited area, but two distinctly different oils, betraying an entirely separate origin, are produced from immediately adjacent wells, the line of separation between light oil and heavy oil territory being unmarked by any surface indications, and only determinable by drilling. The production of the light oil end of the field is comparable to that of Puente, both in quality and quantity. The average per well production of the Fullerton field is considerably larger than that of Whittier, Puente, and Los Angeles, and approaches that of Salt Lake, but the maximum production of the latter field is far greater than that of any other district in this end of the State, and in a few cases has been comparable with the performances of all but the best wells of the northern fields.

The Ventura-Newhall group is hardly to be called a field, but is rather a succession of small fields, some clearly distinguished, a few possible of connection with other groups. This is not the place to distinguish between these little pools, but it may be said that, while they differ greatly in the character of the oil produced, so far as physical properties go, the chemical resemblance is strong throughout, and a common origin is indicated. It is probably safe to ascribe the separation of these pools, and the differing physical characteristics, rather to an unusual degree of fracturing than to any material variation in the character of the producing formation, which is uniformly hard, and therefore gives wells of small individual production. Some of the individual groups, however, show marked peculiarities of structure, which will be detailed in their proper place.

The little Summerland group gives the only production which has been found along the south coast of Santa Barbara County, and certain peculiarities of this region, which will be detailed later, suggest that

this tiny pool is a sort of stray sand, and does not indicate the presence, or even the probability, of similar pools in like situations. This is a typical California field, producing heavy and viscous oils from loose sand, interbedded with soft shales and clays.

The Santa Maria oil field consists of three quite distinct groups of wells, producing, however, from the same type of formation, and giving an oil of the same general character. The "Old Field," or Santa Maria field proper, produces mainly from fissured, sandy shale, the density of the shale being such that there is every reason to believe that the productive capacity of individual wells depends rather on the degree of fissuring than on the holding capacity of the shale itself. Production per well has, therefore, varied greatly, and in some cases has been extremely large, and even now the average for the field is very satisfactory indeed. This oil is marked by a uniformly high gravity, and by certain chemical peculiarities which can not be described, but which sharply set it off from any other oil known to exist in California. The most apparent of these peculiarities it shares with the oils of Salt Lake—a very high percentage of sulfur, and a much greater degree of volatility than would be indicated by the gravity, but the resemblance ceases here, the oils of Salt Lake being in other respects quite normal.

The Cat Cañon, or "East Field," produces from formations of the same general age as those of the old field, but the oil is found in loose sand. It is much heavier than the oil of the old field, being somewhat heavier in gravity than the oils of Kern River, and of considerably greater viscosity, but shares with the former in marked chemical peculiarities, which point toward a common origin for the two. The same may be said for the oils of the Lompoc group, which are intermediate in gravity, ranging from 16° to 18° Beaumé. The Cat Cañon field is too little developed to give any definite idea as to its productive capacity as a whole, but the output of two or three of the earlier wells has been, and still is, very large. The per well production in the Lompoc group is rather variable, but apparently has not been so great, though still very satisfactory as a whole.

Of the total area of this end of the State, the amount from which oil has been produced, or which has been seriously tested, is but a minute fraction. Much of it, of course, is high mountain country, exposing rocks which at once preclude the possibility of the presence of oil. Other is valley land, in which the country rock is deeply buried beneath layers of silt and sand. Yet, allowing for such deductions, there is still a great deal of yet untested territory, and it is hardly possible that of this some at least will not ultimately be brought to production.

The object of this report is not to point out the possibilities of untested areas, for such would be an unending labor, but rather to sum-

marize and describe the work already done, and draw from it such conclusions as may point to the prospects for extending those areas already producing.

To this end, we will first consider the fields already named, and thereafter give such data as are obtainable regarding work done outside of these fields. The fields will be found described under their recognized names, while work done outside the bounds of these fields, as mapped, will be divided according to the counties in which it was performed. The names of companies now operating or having operated in various fields will be found in the index, and arranged geographically in each field.

CHAPTER II.

METHODS OF OIL ANALYSIS.

In the following pages a number of analyses of crude oils are given. As these analyses, and others with which they may be compared, were made by various persons and stated in different ways, it is necessary to explain in some detail the extent and the bearing of these differences, as otherwise the analyses given herein would be little more than a collection of meaningless figures.

An oil analysis differs materially from the ordinary mineral or organic analysis in that it can not be reduced to any absolute basis. For instance, in analyzing a sample of water, we find certain quantities of, say, sodium clorid, calcium sulfate, magnesium sulfate, and other salts, each of which is a definite chemical compound, subject to exact measurement. And, therefore, the analysis has an absolute basis—if we correctly determine the quantity of each salt, and check the sum against the total solids in the water, we know to a certainty that we have discovered and estimated all the dissolved matter, and that the balance to make up 100 per cent is pure water. And so it follows that if any number of identical samples be tested by different observers, at any time or place, the results will be identical, provided the work be correctly done.

So in ordinary organic work, such as wine analysis, the sample may be divided into water, alcohol, sugar, essential oils and coloring matter, all definite substances, capable of exact estimation, and therefore again the results on identical samples must always be the same, if the analysis is accurately made.

This absolute basis is entirely lacking in the case of an oil analysis (the word oil here used to mean petroleum only). A crude petroleum is a mixture of a very large number of separate substances, many of which have never been isolated and described, and even could the analyst separate and estimate the quantity of each of these in the sample submitted to him (which for several reasons he can not), the result would be of interest only to the research chemist, and have no practical value.

The commercial value of a sample of petroleum depends on two factors—the percentage of valuable constituents, and the ease with which these more valuable elements may be separated from those of less value and brought to the state of purity demanded by the market. The rational object of the commercial oil analysis is, therefore: first, to separate the oil into such commercial products as have the greatest aggregate value and determine the quantity of each; and, second, to

form an opinion as to the ease with which this process may be carried may be met, within limits, by suitable analytical methods; the second of making first-class products on a large scale. The first requirement may be met, within limits, by suitable analytical methods, the second calls for skill and judgment on the part of the operator.

In separating a small sample of oil into the most desirable commercial fractions, and determining the quantity and quality of each fraction, we meet at once three difficulties, which we seek to avoid, so far as may be, in the following manner:

The first difficulty is, that the products of different oils, even when sold under the same name, are not always identical in properties. For instance, the gasoline now on the market in California varies from 58° to 62° Beaumé in gravity. Any refiner knows that if an oil gives a certain yield of 62° gasoline, it will give a much larger yield of a gasoline of 58° gravity, and correspondingly less of the next fraction. This variation in specifications holds good for all petroleum products, and can be met in but one way—by selecting arbitrarily such specifications as give the nearest approach to average refinery practice, and adhering to these specifications in all analyses. While this sometimes does an injustice to individual oils, it is probably the only method feasible for a large number of analyses.

The second difficulty is that an oil can be made to give a number of overlapping products. This applies particularly to the lubricating end of the crude, and makes it impossible to give figures having more than a suggestive value. For instance, whole series of dynamo, neutral and other light oils, of red oils of various colors and viscosities, of skid oils and grease stocks, and of gas and steam cylinder oils, may be made from almost any crude by various methods of distillation and treatment. But from any one batch of crude but two, three, or four kinds of oil can be made, all other possible oils being made from the same portions of the stock by different refinery manipulation. Thus, a complete analysis of the heavy end of a crude becomes extremely complicated, and in a small scale analysis we can do no more than to bulk together all those portions of the oil having any lubricating value, and give the principal properties of the average product thus obtained. This, of course, gives only a very general idea of the value of the crude oil as raw material for these products.

The third difficulty is a very serious one, and can be surmounted only in part, and that by very careful selection and regulation of laboratory methods. This difficulty is, that the products from any given oil, even when made to set specifications, are not always the same, but depend to a large extent on the conditions surrounding distillation of the crude. This condition is due to the fact that the distillation products of

petroleum do not entirely exist as such in the crude, but are formed by a partial decomposition of the oil during distillation, and the quantity and quality of various products yielded by the oil is materially influenced by the extent to which decomposition is allowed to take place in the crude still. For instance, a sample of heavy crude may be distilled with the least possible decomposition, giving an average distillate of, say, 18° Beaumé, and a certain percentage of asphalt of a certain degree of purity. By so conducting the distillation as to greatly decompose the oil, the average gravity of the distillate may be greatly increased, up to 30° Beaumé, or even more, by which the lubricating oils are almost entirely destroyed; this treatment considerably increases the yield of asphalt, but much diminishes its purity.

This excess decomposition is sometimes advantageous in practice (within limits), but, as a rule, is avoided as far as possible, and in making small scale analyses the only safe rule is to keep decomposition down to the lowest possible terms. This is by no means easy, even when all precautions are taken, and analyses made under conditions of great decomposition, as where the crude is distilled dry in glass flasks, are valueless so far as the lubricating end of the oil is concerned. The various means used to reduce decomposition are described in later paragraphs.

Where due precautions are followed in the selection of a working method, analyses on even a very small scale may be made to produce results agreeing very well with those obtained in practice. The different series of analyses quoted in the following pages differ in this respect, and an attempt will be made to show how far the results in each series may be depended on.

Selection of Samples.

Considering the extent of territory covered by this report, and the number of producing wells therein, it will be evident that even to obtain, much less to analyze, a sample from each well, is entirely out of the question. In order to keep the number of analyses within reasonable bounds, and at the same time cover the range of qualities as fully as possible, the following plan was adopted.

The entire field was divided into small groups of wells, which apparently draw their oil from a common source. Thus, in the Ojai Valley and vicinity, the Pirie wells, the Sulphur Mountain wells, the group on the divide between Ojai and Sisar, and the Silverthread group, may each be considered as a unit, the probabilities being that all the wells in each group produce from the same sand or succession of sands.

From each group the greatest possible number of samples was obtained, and the gravity and viscosity of each noted, as well as any peculiarities of color and odor. Samples of maximum and minimum

gravity were then taken for analysis, and, where this range is at all considerable, one or more samples of intermediate gravity. Where any great differences of color and odor were observable, samples showing these peculiarities were also taken, regardless of gravity.

Thus, for instance, in the Upper Ojai group, all the samples were of the usual blackish brown color, with the flat sweetish odor characteristic of San Joaquin Valley oils, and of normal viscosity for each gravity, and all gave a precipitate of asphaltene on dilution. The assumption was thus highly probable that all the oils of this group were of the same general nature. The gravity range was from 11.8° to 19.3° Beaumé, and samples of these two gravities were taken for analysis, as well as two samples of intermediate gravity. As these four samples show a very regular gradation of properties, it is quite safe to assume that oils lying between these in gravity would have corresponding analyses.

In some of the Ex-Mission groups, however, we find two distinct classes of oils—those of the usual blackish color, giving a normal amount of asphaltene on dilution, and oils of a lower gravity, but of a greenish color, giving little or no asphaltene precipitate. In such cases, samples of maximum and minimum, and in some instances of intermediate gravity, from both classes, were analyzed.

Source and Classification of Analyses.

Only a portion of the analyses given herein were made for the purposes of this report, as on account of the great labor involved in this work it was not thought necessary to duplicate satisfactory analyses which had already appeared in print. Where such are used, however, they have, so far as possible, been recalculated to bring them to uniformity with the later analyses in order to facilitate comparisons. It is well known that several analyses of a single oil may be given, so different in appearance that only on the most careful examination would it appear that the same oil was being described, yet all equally correct, the difference being solely in the manner in which the results were presented. It will be apparent that where a large number of analyses are given, the usefulness of the figures will be greatly increased by a uniform method of statement. So, in all cases where the analysis in its original form gave the results according to temperature fractions, or in a different set of gravity fractions from the standard adopted, these have been recalculated to percentages of the standard gravities adopted in later analyses. But as such calculations are not absolute, depending to some extent on the judgment of the analyst, the original temperature and gravity fractions are also given, to enable the reader to make his own deductions if he so desires.

The analyses given in the following pages are divided into six classes,

according to their date and origin, and distinguished by series of numbers, as follows:

Numbers 7400 to 7499. These were made in 1902 by Mr. H. N. Cooper, and published in Bulletins 31 and 32 of the California State Mining Bureau. As the method followed was dry distillation into temperature fractions, the results have been recast as above stated.

Numbers 8400 to 8499. Collected from various sources and made by various methods, which are individually described in connection with the analysis.

Numbers 400 to 499 and 1400 to 1499. Made in the writer's laboratory between 1899 and 1902 by various methods, individually described.

Numbers 2400 to 2499. Made by Messrs. Wayne Colver and Edward N. Moor, and by the writer, in 1902 and 1903, and in part published in Bulletin 32 of the California State Mining Bureau. These have been recalculated to later standards.

Numbers 3400 to 3499. Made by the writer since 1903, by a method similar to that followed with the next series, and recalculated.

Numbers 4400 to 4499 and 5400 to 5449. Made in 1910 and 1911, by a method specially worked out for comparing small samples. This method is described in detail below, and forms the basis with which the other results here given are compared.

Analyses Having Numbers Between 4400 and 5449.

As these results are taken as a basis for comparison, the method by which they are arrived at will be first described. These analyses were made by J. P. Prutzman & Son, Petroleum Engineers, by whom they were contributed to this work. The samples, except as otherwise stated, were taken by field assistants of the State Mining Bureau.

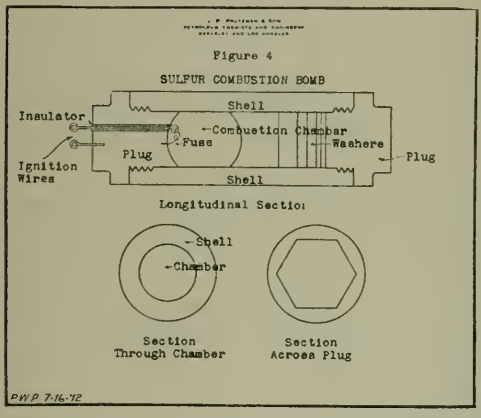
Gravity. These tests were made, except in a few doubtful cases, with glass hydrometers, accurately standardized at two or more points by checks against Westphal weights. In the hands of a skilled operator, hydrometer readings properly corrected for meniscus and temperature are quite accurate enough for all ordinary purposes, and are considerably more accurate than the figures usually had in the field and refinery. Where calculations of volumes to weights were to be made, or in any case where extreme accuracy was desired, the Westphal balance was used, as being much more rapid than pienometer weights, and at least as dependable.

For temperature corrections, the factor 0.07° Baumé per degree F. was used throughout. This factor is absolutely accurate only within a very limited range of gravities, the true correction ranging from about 0.05° at 10° Baumé to about 0.09° at 70° Baumé. As all readings, however, were made between 50° and 80° F., and most of them between 60° and 70°, the error thus introduced is inappreciable.

Viscosity. All the tests given herein, except where otherwise stated, were made with an Engler instrument, standardized with water. The viscosity of distilled water at 60° F. is taken as unity.

Flash tests. These are the usual open cup tests, standard in the trade. Electric spark was used, and the usual rate of temperature increase followed.

Sulfur. This element was determined by means of combustion in sodium peroxid, in a bomb of the construction shown by attached figure. (See Figure 4.) By using pressure on the mixture, the difficulty sometimes found in getting perfectly white residues is entirely avoided, and there is every reason to believe that the sulfur determinations so made are entirely accurate. A considerable number of tests made by Mr. F. S. Wade, chemist for the Los Angeles Gas and Electric Corporation, in which the results of peroxid combustion were checked against oxygen bomb combustions, gave a very close correspondence in every case. The combustion residues were neutralized, boiled, precipitated as barium sulfate, and weighed in the usual manner.



Nitrogen. Determinations of this element were made by a modification of the Kjeldahl process, in which the oil is oxidized by means of fuming sulfuric acid and permanganate until colorless, diluted, neutralized, and distilled, and the ammonia estimated in the usual manner.

Carbon. A few determinations of total carbon were made by evolution of the carbon dioxid from the residues of peroxid combustions, the gas being read volumetrically. This method is very simple, though not so accurate as tube combustions, and requires to be always run against a blank test to determine carbonates in the peroxid used.

Asphaltene. This determination is made by pouring a small sample of the oil into two hundred parts of a very light gasoline, being the fraction of ordinary 86° gasoline boiling between 100° and 150° F. The oil is poured in very slowly, the gasoline being strongly stirred to prevent precipitation in lumps. The precipitate is then worked on to dried and tared filters, washed first with the same gasoline, then with ordinary 86° gasoline, until the filtrate is colorless, and finally dried at

80° Cent., and weighed. Weight is expressed in percentage of the weight (not volume) of the oil.

Distillation. A sample of 150 or 200 c.c. was placed in a pear-shaped copper flask (oxygen retort), and connected by bent outlet pipe to a glass worm condenser. No thermometer was used, cuts being made entirely by gravity.

The first cut was tested when 5 c.c. had collected. If this proved to be above 61° gravity, further distillate was run in until this gravity was reached. If below 61° on the first test, distillate was run in until a gravity of 52° was reached. This proceeding is open to the objection that the first test on 5 c.c. (or from $2\frac{1}{2}$ to $3\frac{1}{3}$ per cent of the crude) might be below 61°, while a smaller quantity might be above this gravity; in other words, that a very small quantity of gasoline might escape observation. It must be said, however, that no method of even approximating the gravity of extremely small samples of gasoline has yet been devised which does not involve too much wastage and evaporation to permit of adding further distillate should the gravity prove too high. Picnometer gravities may be taken on as little as 1 c.c. of sample, but as the bottle can hardly be charged with a loss of less than one half c.c., and the pouring back and forth seriously lowers the gravity, gasoline thus weighed can not be poured back and added to if it proves too light. While by the use of a delicate float graduated to 61°, if the float sinks in the first drops, distillate can be run in until the float rises, or if it rises in the first drops, the float can be fished out and replaced by a 52° float without any material loss in either quantity or gravity. Of course, it will be understood that percentages determined on such small samples are only approximate, but, while the figures are not represented to be absolutely accurate, it is surprising how closely they do check, in most cases, with the results of actual running tests.

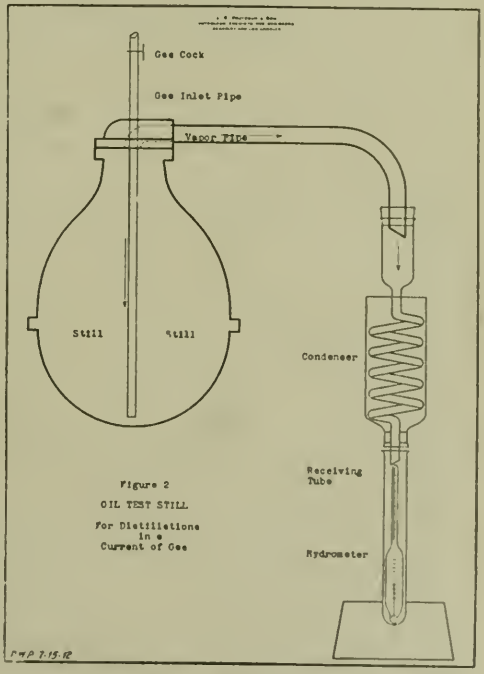


Figure 2
OIL TEST STILL
For Distillations in a Current of Gas

The gasoline, if any, being separated, cuts are made to bulk gravities (corresponding to tank gravities in the refinery) of 52° (engine distil-

late), 42° (kerosene), and 33° (stove oil). At the beginning of this cut the fire is slackened, and a stream of ordinary illuminating gas turned into the oil, through a pipe brazed into the head and reaching to bottom of still. This gas is used in place of "bottom steam" to carry out the heavy vapors and reduce decomposition as far as possible. It is feasible to use steam for this purpose in larger stills, even down to a half-gallon size, but the writer has never been able to devise a practicable means of regulating the admission of the very small amounts of steam permissible in a still taking a 200 c.c. charge. The use of gas for this purpose is rather novel, but it appears to give almost the same results as steam, and is extremely easy to control. It requires considerable baffling in the condenser to avoid the carrying through of a fog of uncondensed vapor.

Distillation is continued, in this method, to a dry coke, the bottom of the still being brought to a dull red heat. The still is then cooled, passage of gas being continued until still is almost cold, and the coke scraped out and weighed—the coke is usually friable and flaky, and readily removed. The yield of coke is calculated to the corresponding amount of D asphalt by multiplying by the factor 2.5. The basis for this factor is given in a later paragraph.

The last fraction now contains all the middlings and lubricants, but the yield is, of course, too large by the difference between the yield of coke and the calculated yield of asphalt. The percentage obtained is therefore reduced by this difference, it being assumed that the distillate obtained on coking the asphalt would contain the same ratio of middlings to lubricants as the earlier part of the cut, and, considering the severe cracking which the coking distillate undergoes, this is not a violent assumption—in any case, the error thus introduced is small.

The total bulk of the last cut, after taking gravity, is put into a small Engler flask and distilled in a current of gas until the distillate shows 28° Beaumé. As this distillation must be done rather rapidly, to avoid burning the residue, the exact gravity is rather difficult to strike, and in practice the gravity of distillate obtained varies somewhat, but is stated in each case. The figures for middlings and lubricants are therefore the least certain of any stated in these analyses, but this is true with any method, as the extent to which decomposition takes place in the first run greatly influences these figures.

Finally, the residue from the last distillation (green oil) is shaken for five minutes with exactly 5 per cent of its bulk of 66° commercial sulfuric acid (added from a burette), allowed to settle, exactly neutralized, and cleared. The gravity, viscosity and color of the red oil thus obtained are noted. The light fractions (52° and 42°) are also treated with small doses of acid and neutralized—the color after treatment is

indeterminate, as a trace of outside impurity will throw these off considerably, but the odor and the behavior of the acid will usually throw some light on the readiness with which these oils will treat out in practice.

Where proper arrangements are made for carrying on several analyses simultaneously, the time required by a skilled operator is from four to five hours per analysis. In common with all methods using small samples, this scheme gives only approximate results, but, so far as the writer is aware, the results come closer to those obtained in practice than those given by any other method. The following remarks may be made as to the validity of the various figures obtained:

The gasoline percentage is usually fairly accurate. A smaller percentage of gasoline than 3 per cent will not usually be indicated, but will be added to the engine distillate.

The engine distillate is quite accurate, except in the above case, where there is a yield of gasoline too small to measure.

The kerosene percentage is accurate so far as its goes, but as it takes no account of flash test or burning properties (which can not be had on such small samples) the percentage of finished kerosene is not indicated, except by analogy with other oils of the same character. In comparing a number of samples of the same general nature, the amounts of kerosene will be pretty closely proportional to the yield of kerosene stock given in this test.

The figure for first run stove oil is accurate.

The figures for middlings and lubricants are only suggestive, as this part of the stock may be cut in many different ways, and the manner of handling the crude greatly effects the results obtained on a large scale.

The figure for asphalt is considerably more accurate than in any method of direct running applicable to small samples, and is usually within two or three per cent of the actual refining figure for the hardness given. Small scale tests in which the asphalt is determined directly often vary ten per cent, or even more, from the truth, unless they are corrected for hardness.

Analyses Having Numbers Between 400 and 499, and Between 1400 and 1499.

These analyses are from the private records of the writer. The figures were made at various times and for widely different purposes, and the methods used varied considerably. For this reason, a brief description of the operating method is given preceding each analysis in this series, but the general methods followed in making specific determinations, such as gravity, viscosity, sulfur and asphaltene, are the same as in the 4400 series just described.

Analyses Having Numbers Between 2400 and 2499.

These analyses were made in the writer's laboratory, in the years 1902 and 1903, partly by Messrs. Wayne Colver and Edward N. Moor.

A sample ranging from 100 to 200 c.c. was distilled from a glass flask, the distillate being divided into fractions as follows:

Below 212° F., light gasoline.
212° to 302° F., heavy gasoline.
302° to 518° F., kerosene stock.
Residue above 518° F., fuel oil.

The residue, which would be approximately equal to the residue left in practice where all kerosene and lighter oils were taken out, was cooled, the gravity noted, and the lubricating stock then evaporated off in an open pan, until an asphalt of D grade (about 50° D. C. scale) remained.

This method is rapid and convenient, but has two notable drawbacks—the lubricants are lost in the open evaporation, and so no information is gained as to the behavior of the heavy end of the oil on distillation, and the percentage of asphalt obtained on open evaporation is greater than is realized in distillation, owing to oxidation of the heavier oils. The figures for asphalt so obtained seem to be uniformly too high by about twenty per cent of the yield, so that if the asphalt percentages given in this series are reduced by one fifth, the actual yield of asphalt is closely approximated. This deduction is made in each case where such figures are presented.

Analyses Having Numbers Between 3400 and 3499.

These analyses were made by the writer, according to the following method:

First distillation was made in glass, in the same manner as in the series above. The residue, instead of being evaporated down, was poured into a small iron still, and reduced in vacuum to a grade somewhat softer than D, the amount of distillate to be taken off being estimated from the gravity of the residue taken. The asphalt was then reduced to grade by open evaporation, in the same manner as above, but by taking the asphalt nearly to grade in the still the error due to oxidation is greatly reduced, though the results are still a shade too high.

The distillate from these residues (lubricating stock) was then reduced in an iron still, in vacuum, by an amount calculated to bring it to green oil of about 18° Beaumé, though in practice the gravity of the reduced stock varies considerably. It will, of course, be understood that it is quite impossible to withdraw samples during the distillation, as is done in actual still running, so that the amount of distillate to be removed to get a certain gravity of residue must be guessed at.

The same difficulty, of withdrawing samples, applies also to the distillation of crude to asphalt, and in laboratory practice, where attempt is made to run a small sample down to any given grade of asphalt, the resulting product often varies so widely from the standard in hardness that the results as to quantity are quite valueless. This difficulty, in the case of asphalt, may be gotten around in several ways—first, to reduce the residue in an open pan, as above, testing constantly, which makes it possible to get even grades, but requires a correction for oxidation; second, to carry nearly to grade in the still, and then reduce in a pan, which much reduces the error caused by oxidation, but does not obviate it entirely, and is also very tedious; third, to reduce in the still to as near grade as possible, test the penetration, and correct for hardness according to a set percentage-penetration scale, and last, to reduce the oil to dry coke and calculate back to asphalt. By making the proper allowances, any of these may be made to give accurate results, but it is not too much to say that a test made by reducing to grade in the still without penetration test and correction is of very slight quantitative value.

The method given above is an improvement on the one preceding, but is still defective in that it loses a small portion of the lubricants, and thus disturbs both gravity and proportion of that fraction. The vacuum distillations were also found very tedious where a number of samples were to be tested.

Analyses Having Numbers Between 7400 and 7499.

These analyses were made by Mr. H. N. Cooper, and published in Bulletin 31 of the State Mining Bureau. All were made by distillation in glass flasks, dividing the distillate into temperature fractions, and running the heavy end of the oil to asphalt in a manner calculated to carry decomposition to the limit. Full description of the methods followed may be found in Bulletin 31, and also in the final insert table in Bulletin 32 of the Bureau. For the purposes of the present work, these figures have been recalculated as follows:

The temperatures given by Mr. Cooper in degrees Centigrade have been converted into degrees Fahrenheit, the latter scale being solely used in the oil trade.

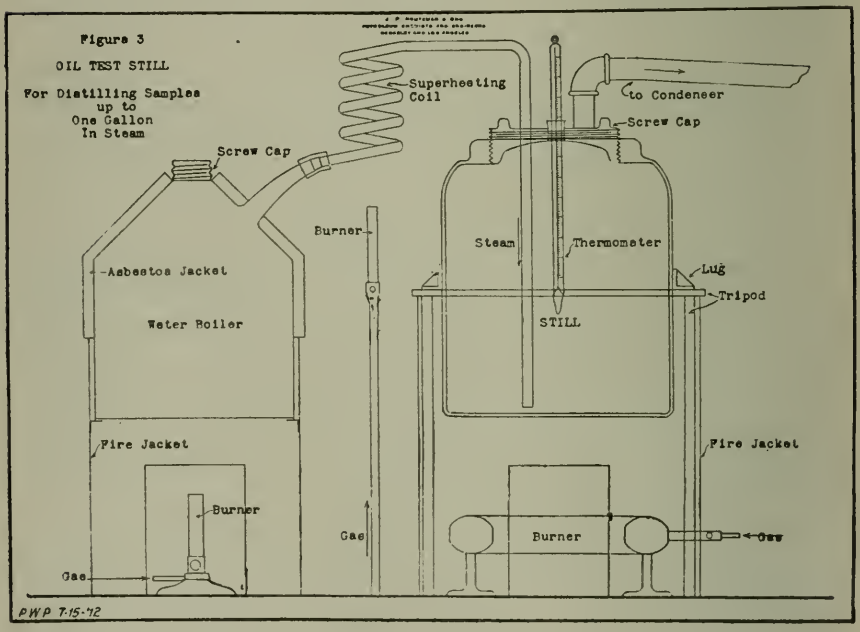
Heat values have been converted from calories to British thermal units for the same reason—that the British standard is in general use among engineers, while the more rational French standard is not.

Fractions are given in Mr. Cooper's original figures (converting Centigrade to Fahrenheit degrees, and specific gravities into the more readily understood Beaumé), and, following these, the various arbitrary fractions are calculated roughly to commercial products of standard gravities, to facilitate comparisons with the other analyses given. Such

calculated percentages are little more than estimates, but probably will be more informing than the original arbitrary figures.

Mr. Cooper's sulfur percentages are from the residues of combustion in an oxygen bomb. Gravities are by picnometer weights. Viscosities are by the Redwood instrument, which, when standardized with water, compares well with the Engler used for the other samples. Flash tests are by the Abel closed tester, and do not compare with the open-cup tests standard in the trade, being very much lower.

The distillations are accurate in the lighter portions, but the method of distillation followed (using a glass flask, and running up to temperature two or three times), entirely destroys the identity of the lubricating end of the oil, and makes this portion of the analysis of very small value. It also seriously affects the percentage of asphalt.



Pirie Ranch, Ventura County, Topa Topa Range in Right Distance.

City of Ventura.

CHAPTER III.

PIRIE, SULPHUR MOUNTAIN AND OJAI WELLS.

Ventura County.

From the city of Ventura, in the county of that name, to Newhall, in western Los Angeles County, a succession of producing localities is found on both sides of the Santa Clara River, and in two locations in the hills north of Simi Valley. These deposits follow the foothills of the San Rafael Mountains from the banks of Ventura River to Piru Creek, but have not, up to this time, been traced farther to the east, nor have many direct indications of oil been found in the mountainous country west of Ventura River.

On the south side of the Santa Clara, production commences farther east, the most westerly developments up to this time being at Bardsdale, south of the town of Fillmore, and from here oil has been developed at intervals to a point somewhat east of Newhall. The two producing localities on the north side of Simi Valley are south of the town of Piru, and of the Tapo and Torrey wells.

Topography.

The Santa Clara Valley is a river wash of no great width, being perhaps three miles wide at Santa Paula, a mile at Piru, and averaging less than half a mile farther east. The river itself is a winter stream, carrying little or no water in summer, but subject to heavy floods during the rainy season, and has the wide, sandy bed characteristic of such streams.

The hills north of the river are in the main quite abrupt, the rolling hills usually found in this part of the State being noted only near Ventura River. North of Fillmore and Piru, the lowest of the hills are steep and rugged, while those farther north are mountains of considerable magnitude. The steep pitch of the hillsides and the sharpness of the cañons have much retarded prospecting in this part of the field.

South of the river, and particularly to the west of Tapo Cañon, the hills are more rounded, and on the Simi side, at least, quite accessible, though somewhat abrupt on their northern face. East of Tapo the extreme roughness noted on the north side of the river is again manifest, and in the neighborhood of Pico Cañon the country is so rugged that a number of oil-well sites are inaccessible by road, and reached only by trails.

Climate.

The climate of this territory is a compromise between that of the coast and that of the interior. The entire region is rainless in summer, but at the lower end of the valley the heat is much moderated by con-

stant sea breezes and occasional fogs. Farther east the climate much resembles that of the lower San Joaquin, being extremely hot in summer, and dry at all seasons. As a whole, the climate, which is delightful at the western end and in the higher hills, is tolerable in the least favored portion, and healthful in all parts of this area.

Geology.

The geology of this region, in its broader aspects, has been thoroughly covered in previous works, and may be dismissed here with a word as to two salient features which sharply distinguish this territory from any other producing district of the State, both of these features having a material bearing on the prevailing methods of operation, on the character of oil produced, and on the prospects for extension of known territory.

The first distinguishing characteristic of the geology of this area is the predominating quantity of hard and close-grained rocks in formations of all ages except the very latest. Clays and shales are, it is true, found in some quantity over most of this area, but even these are, as a rule, thoroughly compacted, and the sandstones are uniformly hard and close grained, merging into quartzites in the lower members. The prevailing hardness of the rocks penetrated brings about two important results, the first, that a large part of the drilling troubles encountered in the soft rock fields (such as the San Joaquin Valley) are here unknown. This is, to a certain extent, offset in practice by the boulder strata found in some of the later and upper formations, and by the inclination of the strata, but it is yet a fact that the absence of quicksand, running oil sands, sticky clays, and caving shales make both drilling and production much cheaper in this district than in those of heavier production and softer formation. The second result is that over almost the whole of this area the production of individual wells is small, fifty barrels per day being considered a large production, and the average being a fraction of this amount. This again is offset, in many cases at least, by the high quality of the oil produced, and by the unusually low cost of maintenance and operation which follow from production out of hard sands.

The other characteristic feature of this district is the very unusual degree of folding and faulting to which the rocks have been subjected. At least two great faults, and numberless minor ones, are found here, and while a modified anticlinal structure may be traced at many points, and has a certain connection with the location of the oil deposits, these

A valuable collection of data and observations as to the geology of the Ventura-Newhall district may be found in "The Santa Clara Valley Oil District," by the late Geo. H. Eldridge, published in Bulletin 309 of the United States Geological Survey. A number of interesting notes as to the structure and developments at various points in this district will be found in Bulletin 19 of the California State Mining Bureau by W. L. Watts.

anticlines are most, if not all, considerably faulted, and it is highly probable that a true anticline, in the sense of the unbroken arch found in many of our fields, does not exist over the entire area in question. It follows from this that, because of the steep and variable inclination of the producing strata, the oil-yielding districts are disconnected, and of small area, and, the limits of each pool being reached, the question of the possibility and direction of extension is uncertain in the extreme. As a rule, the existence of productive formations is probably indicated by seepages, which are extremely numerous, and from which all the productive areas have been traced, but over the extensive areas which do not show seepages the location of prospect wells is a very difficult matter, and large sums have been spent in unsuccessful work of this nature. The extremely variable character and value of the oil produced is also due to this excessive fracturing, oils of the most divergent qualities often being produced within a very small area, or even from the same well.

These points will be dwelt on at more length in describing the different sections of this district, but for the present it will be sufficient to emphasize the fact that this district is not, in any sense, a single oil field, but is rather a succession of small pools, some of which may, but many of which apparently may not, be connected by later developments.

Subdivisions.

Because of the variability above pointed out, it is impossible to give any adequate description of this district as a whole, and yet a satisfactory scheme of division is difficult. In presenting the following notes, a scheme has been adopted which, while not perfect, seems to make reference as easy as is possible under all the circumstances. This division is as follows:

Townships 4–24, 4–23, 4–22, and 3–23. This includes
- Wells west of Ventura River.
- The Pirie wells, near Nordhoff.
- Wells in Ventura River Valley.
- The Sulphur Mountain wells.
- The Ojai wells, which have not yet been connected with those of the Silverthread group. The Burrows and Aliso wells, on the Ex-Mission, which fall into this township, are reserved for the next group, because of their plain connection with the Adams and Saltmarsh wells farther east.

Township 4–21. This includes
- The Slocum, Adams, Tar Flat, Saltmarsh, Burrows, and Aliso wells, on the Ex-Mission.
- The Silverthread group of wells, along the north bank of Sisar Creek.

The O'Hara wells, on the east side of Santa Paula Cañon.
The Empire wells, and three or four prospect holes adjacent, but situated in township 4–20.

Township 5–20. This includes
The heavy oil wells of the upper Big Sespe, which have not been connected with the Tar Creek wells farther east.

Townships 5–19 and 4–19. These cover
The Tar Creek, Squaw Flat, and Little Sespe wells, which appear to belong to a single formation.
A few scattering prospect holes along lower Sespe Cañon, in 4–20 and 4–19.
The Hopper Cañon wells.

Townships 3–20 and 3–19.
These include the Bardsdale wells only.

Townships 4–18 and 3–18. These include
The Modelo wells.
The Temescal wells and a number of prospect holes to the east of the Temescal and covering the western part of 4–19.
The Torrey wells.
The Tapo wells.
The Eureka wells.
The Simi wells.

Townships 4-24, 4-23, 4-22, and 3-23.

The valley of Ventura River lies along the western side of township 4–23, this river running from north to south, and draining into the Pacific Ocean at San Buenaventura. Ventura River rises in the main range of the Santa Ynez Mountains, which follow the coast, lying almost due east and west, from Concepcion, in Santa Barbara County, to the Ventura County line, and which, under the name of San Rafael Mountains, are continued quite across that county. At the western border of this county, a spur takes off to the southeast, Casitas being at or near the pivotal point, and continues as far as Santa Paula Creek, where it again merges with the main range. Ojai Valley, lying east and west between these two ranges, is distinctly a valley of formation, that is, its origin is due to earth movements, while the narrow valleys, hardly more than cañons, of Ventura River and Santa Paula Creek, are plainly eroded channels, cutting as they do across the strike of the formation.

The mountains to the west of Ventura River are of somewhat later age than the formations of the main Santa Ynez range, and in their lower portions, at least, consist of unaltered sedimentary rocks. No direct indications of petroleum have been found in these mountains, and while some results have been claimed for wells drilled near Casitas

Ventura River, Looking North.

Bituminized Shale and Sandstone, Hall Cañon, Ventura County.

and on Chismahoo Mountain, these reports are not so conclusive as might be desired, and this territory must for the present be considered as untested.

Ojai Valley is a rather flat table-land, lying some seven hundred feet above sea level, and extending to the west beyond the bounds of township 4–23. At this point the width is some three miles, at Nordhoff perhaps one and one half miles, and some two miles to the east of this town the lower valley terminates in a low ridge, ranging from northwest to southeast, and lying between San Antone Creek and Lyon Creek. This is a well-watered, fertile, and prosperous valley, consisting of pasture lands studded with oaks, and of highly cultivated fields and orchards.

Upper Ojai Valley is separated from the lower valley by the ridge just mentioned (which is, indeed, hardly noticeable at its eastern side), and lies much higher, being from fourteen hundred to fifteen hundred feet above sea-level. The drainage crest of this valley, which is imperceptible to the eye, lies near the west line of section 12, 4–22, drainage to the east being down the cañons of Sisar and Santa Paula creeks. At its western and wider end, the upper valley is some two miles wide, and drains into Lyon Creek—it consists, like the lower valley, of orchards and grain land, and, like that valley, has a mild and delightful climate.

The foothills of the San Rafael and Santa Ynez mountains follow closely the northern limits of these townships, and toward the east are known particularly as the Topa-Topa Mountains. These are very steep and rough hills, crossed only by trails, and consist of unaltered or locally-altered sedimentary formations, having a prevailing dip to the north, *i. e.*, into the mountain. The whole northerly boundary of these two valleys is undoubtedly due to a profound fault. As this northerly dip exposes the edge of all strata to a very considerable depth, it is probable that the absence of seepages in these hills is a safe indication of the absence of petroleum along the upthrust side of this fault, though the possibility remains that such deposits may be found in the later and upper deposits further to the north. On account of the inaccessibility of this territory, it has been but little prospected, and the strip of mountain country lying between Matilija and Cuyama Valley is probably as little known as any part of the United States.

Sulphur Mountain is a ridge of considerable height (varying between 2500 and 2750 feet) and of very peculiar formation and appearance. The formation, which will be described in more detail in a later paragraph, consists in brief of an upthrust fault both north and south, with a pronounced synclinal arch between. In other words, of a long and narrow block raised several hundred feet above the surrounding country, and depressed along its main axis. At the east, this ridge terminates

abruptly, probably by faulting at Santa Paula Creek, while at the west it is gradually depressed, and loses itself in the formless group of hills east and south of San Antone Creek. This ridge is thus distinguished by being of an age and a structure quite distinct from those of the valley to the north and the rolling hills to the south, by its very steep, indeed almost precipitous sides, and by many of its cañons having a general direction parallel to the axis, the latter a most unusual occurrence.

South of Sulphur Mountain is an area of rolling hill land, embraced in the Ex-Mission and Cañada Larga grants, and extending to the south as far as the Santa Clara River. This territory is more fully described under township 4–21.

We thus have within the limits of these two townships six distinguishable areas, of which four have produced oil, as follows:

The mountainous area west of Ventura River—some developments, but no discovery.

The mountainous area north of the two valleys—no developments and no apparent prospects.

Lower Ojai Valley—discovery on the Pirie Ranch, near Nordhoff, but no present production.

Upper Ojai Valley—production from the so-called Ojai wells.

Sulphur Mountain—discoveries on the main ridge, in 4–22, and in Lyon Cañon, but no present production.

Ex-Mission tract, with scattered but long-established production.

Wells West of Ventura River.

Four wells drilled just east of Rincon Creek, though in Ventura County, belong properly to Santa Barbara County developments, and will be mentioned in connection with the south coast of that county.

Arctic Oil Company. Drilled two wells on the east flank of Chismahoo Mountain, on the west of Coyote Creek. The first was in the southeast quarter of section 8, 4–24, was drilled in 1897 to a depth of 1669 feet, and is reported as a dry hole.

No. 2 was drilled in 1898, and was approximately 2000 feet deep. This well was reported as having had a trace of oil, though parties concerned in drilling the well deny this. This well was located on the southeast quarter of section 5, 4–24. Both these wells were in the high hills, at an elevation of nearly 3000 feet.

Western Coast Oil Company. This company drilled two wells in the hills east of Casitas Pass. No. 1 was in section 34, 4–24, east of the pass, and south of the Ventura Road. This well was drilled in 1900, to a depth of about 1500 feet, and is reported as a dry hole.

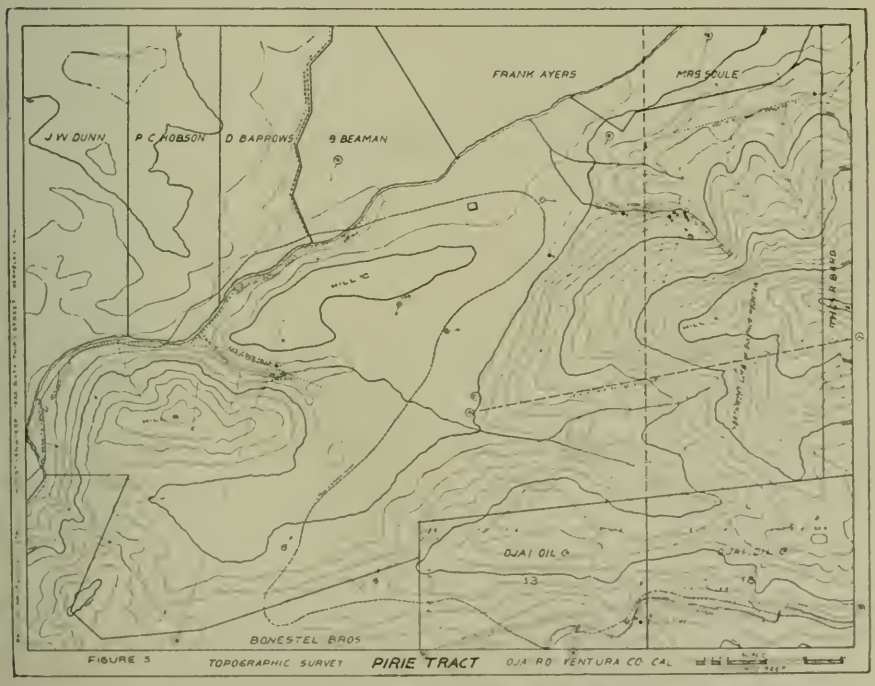
No. 2 was drilled in 1901, at the junction of Willow Creek and Coyote Creek, in the northwest quarter of section 36, 4–24. This well was 1635 feet deep and was abandoned on account of caving formation.

It baled enough oil near the bottom to enable the collection of small samples, and was considered an encouraging prospect.

A well is reported to have been drilled in Cañada del Diablo, on the Cañada de San Miguelito Rancho, section 29, 3–23. No information could be had.

Pirie Wells.

The tract on which these wells are located is known as the Pirie Tract, in sections 12, 13, and 14, 4 N. 23 W., and in 7 and 18, 4 N. 22 W. (See Figure 5.) This tract approximates 1200 acres in area, and is located, geographically, at the western end of Sulphur Mountain, on the south side of the lower Ojai Valley, at the mouth of Lyon Cañon, and on the southeast bank of San Antone Creek.



The central portion of the ranch consists of a flat valley, or swale, sloping gently toward the northeast. This valley terminates at the south in a low, rounded ridge, which divides it from Lyon Cañon. At the west end of the property is a hill some 450 feet in height (above the valley floor) sloping gently to the south, and sharply to the north and west, dividing the valley from San Antone Creek.

Tar Cañon lies at the northern foot of this hill, and north again lies a lower rounded hill, sloping gently to San Antone Creek on the north.

East of the valley lies the foot of Sulphur Mountain, rising sharply

at most points, but folded into synclinal structure, which leaves a wide cañon roughly parallel to the southeast property line. The other cañons in these hills are short and abrupt, and the hills themselves are steep and brush-covered. The principal elevation is noted on Figure 5 as Hill "A."

Every portion of this tract, excepting the extreme southwest corner, drains into the central swale, and thence into San Antone Creek on the north, and also, by means of Tar Cañon, into the same creek on the west. An imperceptible divide separates the drainage of the two ends of the swale. The topography is illustrated by Figure 5.

Seven wells have been drilled within the bounds of the Pirie Tract, and one just across San Antone Creek to the northwest. These were as follows:

Philadelphia-California Petroleum Company, a well on the P. T. Hobson Tract. This well was drilled in 1864, and cased at the surface with a most remarkable cast-iron pipe, about eight inches in diameter and an inch thick—this is still visible. This well was abandoned at 843 feet on account of lost tools, and found no oil.

Ezra Taylor of Nordhoff drilled two wells in Tar Cañon in 1893. These were drilled with a light hand rig, and cased with riveted pipe. The first was 85 feet deep, and was carried into an oil sand, which did not produce enough to pump.

The second well was drilled in the same year to a depth of 333 feet, and stopped on entering sand. There were traces of oil at 90 feet, and, as this well is directly along the apparent line of strike from No. 1, this was probably the same sand found in that well at 85 feet—the surface levels are practically the same. On striking the sand, this well commenced to flow water and oil, and continued to flow twenty barrels of net oil per day for a month or more, and thereafter pumped a slowly-diminishing quantity for more than a year. The railroad had not at that time been built, and the lessees of the property built, in the following year, a pipe line connecting with the main Silverthread line, eight miles distant. This well was cased with 4-inch riveted pipe, and no attempt was made to shut off the water nor, so far as can be learned, to keep the well clean. It pumped considerable water at all times, and gradually dwindled to a small output, and was abandoned after the later wells failed. It is probably still good for two or three barrels a day.

The third well was drilled by the owner of the property, John Pirie, and was within eight feet of Taylor No. 1, and apparently down the dip. It encountered the same dry sand at 125 feet, and was carried to a depth of 500 feet, in red rock, without encountering further indications.

The fourth well was started by John Pirie, and finished by the Union Oil Company with a standard rig. This was twenty feet up the dip from the producing well, and is said to have had traces of oil, though it never produced, and certainly did not encounter the sand which produced in the second well. It was carried to about 900 feet, finding gas at or near the bottom—this is still being collected as it rises through the water and used for household purposes.

The fifth well was drilled by the Union Oil Company in 1894, and was located directly on the brea bed in the bottom of the cañon. This well was drilled to 950 feet, and abandoned in salt water, without finding any traces of oil.

The sixth well was drilled by the Union Oil Company in the same year, in the edge of the valley at the west end of the same hill. It was abandoned at a depth reported at 500 feet, in quicksand, without finding any traces of oil.

The seventh well was drilled by the Union Oil Company in 1894, immediately on the fault line on the north bank of Tar Cañon. No definite data can be had as to the results from this well, other than the depth, which was close to 1500 feet, but it is reported to have found traces of oil at several points.

The age of the formations appearing on this tract is given by Eldridge (Bulletin 309, U. S. Geol. Sur.) as Eocene, the Middle Sandstone of the Sespe Series. As oil is very much in evidence at a number of points in this vicinity, the age of the strata was considered of minor importance, and no attempt was made to verify. The description given of these deposits, "brownish-red sandstones and conglomerates, with minor layers of sandy and muddy shale," applies to the rocks here observed.

The detailed structure of this tract and its immediate vicinity is rather complicated, and lacking any adequate number of exposures, and details as to the old wells, can not be determined with certainty at all points from work done up to this time. The main features, however, may be taken as follows:

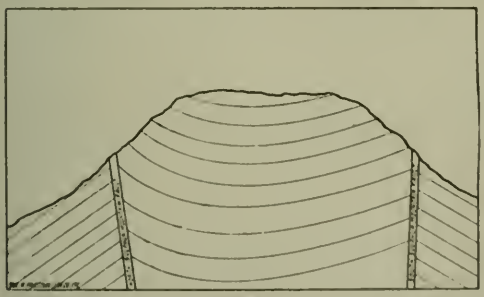


FIGURE 6.

The ridge known as Sulphur Mountain has, farther to the east, the structure shown in Figure 6 (which must be considered highly generalized). That is, it is a syncline, faulted away at both sides.

Toward the west end, however, and where it enters this tract, the ridge divides, extending one arm west and one southwest. The western arm terminates along the east line of the Pirie tract, the southwestern

runs some distance farther to the west, and terminates at the Ventura River. Lyon Cañon lies between the two arms, and follows a fault separating what appears to be a duplication of the synelinal structure. The general structure down the township line separating 4–22 from 4–23 is shown in Figure 7, which again is very highly generalized.

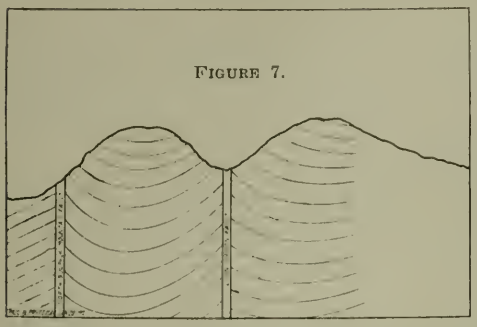


FIGURE 7.

This synelinal structure is well developed at the eastern end of the Pirie tract, and I can find no trace of the anticline which is reported as extending across the center of the tract. While this is given by a very competent authority, I am inclined to think that this anticline had been assumed to extend farther to the west than the facts warrant, probably on the strength of examinations made farther east.

Along San Antone Creek, near the northwest corner of this tract, all the exposed strata dip to the north. Along Oil Well Cañon they dip to the northeast and southwest respectively, but the exposures on the two sides do not correspond, and I consider this cañon as exposing a fault line, the south being the upthrow side.

Lyon Cañon, near the east side of section 13, shows exactly the same structure, and the formation dips away sharply on each side. The structure along the line C–C (Figure 5) would thus be as in Figure 8. This is scaled, and I believe it to be accurate in the main.

FIGURE 8.

At the west end of the tract, the elevation indicated on Figure 5 as "Hill B" is evidently a fault block, raised on its north and west sides, Tar Cañon following the north fault line. Exactly the same structure is shown along Tar Cañon, the formation dipping away in both directions. Exposures are lacking to determine the structure of "Hill C," but from the dips along Tar Cañon, and the very evident upthrow along the south bank of San Antone Creek north of this hill, I am inclined to consider it a minor fault block, dipping to the north at a

low angle. The structure along the line D–D would thus be as in Figure 9.

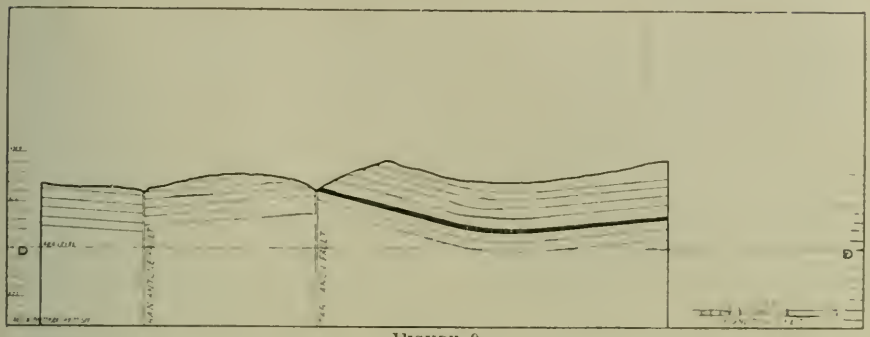


FIGURE 9.

Referring again to the developments south of Oil Well Cañon—it will be noted that the wells known as Taylor 1 and Pirie 1, which are but eight feet apart, showed a dip of the sand of 41 feet, or nearly 78 degrees. On all sides of the hill where there are exposures the dip is extremely uniform at 21.5 degrees. The variation between these two figures, and the fact that the fourth and fifth wells did not encounter the sand at all, may be accounted for in two ways.

The first is, that all these wells were drilled in a zone of crushed fault material, and did not enter the oil formation at all, No. 2 finding merely a pocket containing seepage from sands in the unbroken formation. (See Figure 10.)

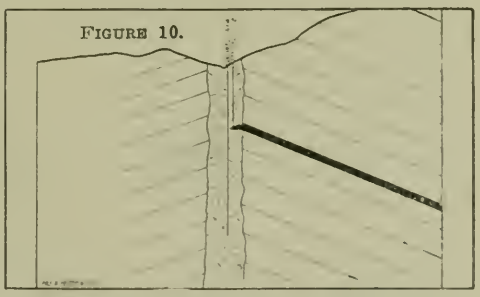


FIGURE 10.

The other explanation is, that in the immediate vicinity of the fault the edge of the formation is sharply upturned. (See Figure 11.) I prefer this view for three reasons—one, that if the oil in No. 2 was stray oil, it is hardly likely that four other wells, one only twenty feet distant, should have failed to find some of it. Another, that so far as the records, and the recollections of the first driller can be trusted, these wells were clean drilling, and gave no indication of the shattering noted, for instance, in the Upper Ojai wells, where the oil is found to be in stringers of crushed shale in broken ground. To this

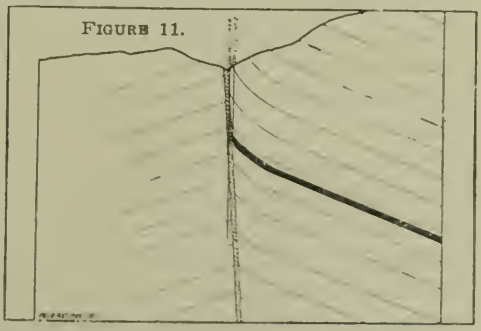


FIGURE 11.

may be coupled the fact that the oil obtained from No. 2 was of high gravity, and not the oxidized and debased oil usually found in badly broken formation. And the last, that some small surface exposures may be found which show a very high degree of dip in the direction indicated, in the immediate vicinity of these two wells. The reason for No. 4 not striking the sand is indicated in Figure 11. It must be borne in mind that all the faulting spoken of here was of very small magnitude, and did not lead to extensive disturbances of the formation.

But in either case, the fourth and fifth wells were very evidently back of the formation carrying oil, and the prospects are all in the opposite direction. It is impossible to determine the exact depth at which sands lie, but in Figure 9 I have estimated from the data at hand, and in any case the error can not be very great, assuming, of course, that no other sands lie below those evidenced on the surface. Nor can it be certain how far the productive sands extend to the west, but it is probable that they reach well toward the axis of the syncline (which is shallow, and not likely to carry much water) and possibly all the way to the Lyon Cañon fault. A seepage occurs on the creek bed in section 13 (see Figure 5) and an exposure of dry oil sand just to the east of the seepage, and on the south bank. The Ojai Oil Company drilled for this sand, and, finding it non-productive at this point, continued to a depth of 1500 feet without, so far as can be learned, the slightest trace of oil, and thus it is more than likely that this seepage is fed from the north side of the fault—that is, from the same sands found in Oil Well Cañon.

The results from the sixth well, which was drilled in the valley close to the foot of "Hill A," raises an important question as to whether this abrupt western face of the hill is due to a fault, or to erosion. There is no direct evidence on this point, other than the fact that there are no indications at other points in this neighborhood of any such degree or erosion, but as this well, even at this slight depth, should probably have penetrated the sands found in the second well, had they been unbroken, it is likely that there is a minor fault following the foot of the hill, and that this well was drilled on the downthrust side. Such being the case, there is no way of determining whether oil exists at any practicable depth on the central part of this tract.

In Tar Cañon a moderately large brea bed is found at the point shown in Figure 5, and on the south bank of the creek is an exposure of live oil sand, thickness of which can not be measured. At two points along San Antone Creek, above the mouth of Tar Cañon, are live seepages and exposures of sand, which at one point appear to measure about ten feet of oil sand. Whether this sand is the same exposed in Tar Cañon is uncertain, but I am inclined to believe that it is not, but is a higher sand, not visible south of the cañon. It is highly probable that producing

sands will be found south of Tar Cañon for a considerable distance, deepening to the southward, and north of the cañon as far as San Antone Creek, deepening to the eastward.

The seventh well was drilled, apparently, immediately on the fault line, on the north side of Tar Cañon. An examination of Figure 9 will show why this well, drilled at the point of divergence of the two dips, could hardly have produced any material quantity of oil.

The only sample of oil available was from the second well, where the oil stands part way up the casing. This well has not been pumped for years, and, as the casing is open, the oil has, of course, lost all its most volatile constituents by evaporation. Nevertheless, the gravity is still 22.1° Beaumé. The following is a proximate analysis of the oil as it stands in the well:

Kerosene	41.6°	6.0 per cent
Stove oil	32.9°	8.5 per cent
Gas oil	26.0°	38.5 per cent
Lubricating stock	23.3°	33.0 per cent
Asphalt	Grade "D"	14.0 per cent
		100.0 per cent

The distillates from this oil were very clean and sweet, and the lubricating stock of unusually good color and viscosity. There is, of course, no way to determine how much of the lighter oils originally existed in the crude, but a comparison of the gravity with the analysis shows that this oil is not of the refractory aromatic class found in some parts of the San Joaquin, but has the constitution common to Ventura County oils—that is, a high proportion of middlings, low asphalt, but also a low sulfur percentage and a leaning toward the aliphatic end of the scale in constitution—which gives good refining qualities. The gravity of this oil as it exists in the sand is probably not far from 26° Beaumé.

Wells in Ventura River Valley.

Several wells have been drilled in the river bed, and in the hills just to the east, resulting in the production of some gas and the finding of traces of oil.

Ventura County Power Company. This company has nine wells in the bed of Ventura River, near Casitas Station, producing gas, which is piped to Ventura. Eight of these wells are closely grouped east of the river and north of the county road bridge. These wells penetrate pebble formation from five to fifteen feet thick, then pass into shale carrying salt water and gas, the latter being found from 90- to 225-foot levels. The holes are not cased, except for a conductor at surface, and stand full of salt water, through which the gas bubbles. The most northerly well has very little gas. The total output of these wells runs from 7000 to 8000 feet daily. All these wells made at first a little oil

of very high gravity, said to have been above 50° Beaumé. South of the bridge is a well some 750 feet deep, which got salt water, but no gas nor oil. West of the river and north of the road is an old hole about which nothing could be learned.

Weldon Oil Company. This company drilled three wells east of Ventura River, in township 3–23. No. 1 was on Lot 2 of Rancho Cañada Larga Verde, and was drilled in 1901. This well was abandoned at 900 feet on account of general mechanical trouble.

No. 2 was located close to No. 1, and was drilled in 1902 to a depth of about 3200 feet. This hole was pointed, and is said to have been in clay for the entire length. No oil was found.

No. 3 was located in fractional section 22, 3–23, and was a dry hole at 900 feet.

Philadelphia-California Petroleum Company. Well No. 2 of this company was drilled in 1866 at the southwest extremity of Rancho Ojai, and just east of San Antone Creek. This hole was 473 feet deep, in clay all the way.

Hardison & Stewart. A well on Rancho Cañada Larga, on section 1, 3–23, is said to have been drilled by these parties, the predecessors of the Union Oil Company, about 1870. Depth, 1100 feet; some oil at 700 feet; abandoned.

Scott Tunnel. Probably bored by the same people. Is said to have once produced three barrels daily; still flowing a little light oil. Located just north of above well.

Sulphur Mountain Wells.

The wells of the Sulphur Mountain Group are found in sections 21 and 22, south and southwest of the large brea bed on Lot 3 of the latter section. Nine or more wells have been drilled, as follows:

Philadelphia-California Petroleum Company. At least one well was drilled somewhere near the brea bed, about 1865, but the data is so confused that it is impossible to segregate the results from these wells and those drilled in Silverthread. It is known that oil was obtained, though not in commercial quantities.

Langdell, Newmark & Rowan. These wells are located, No. 1 just south of the brea bed, No. 2 immediately thereon. The first hole was carried to a depth of 1300 feet (date 1901) and is reported to have baled a little light oil at 800 feet. Under the circumstances, this report may well be questioned. No. 2 was drilled in 1903, to a depth of 600 feet, and made no discovery after passing the tar on the surface.

Sulphur Mountain Petroleum Company. The first well drilled by this company was finished in 1903. First oil, of about 15° gravity, was struck somewhere about 1800 feet, and was sufficient in quantity

to make a small pumper. Drilling was continued to 2142 feet, passing through some forty feet of productive formation at the bottom, and for a short time pumped about eighteen barrels per day of an oil of 17.6° gravity, and of good quality. Whether the upper oil was cased off, or whether this production represents both sands, can not be learned. After a few hundred barrels had been pumped, water broke in from above in such quantities that the hole could not be saved. No. 2 well, half a mile to the east, was drilled in the next year, but was stopped at 900 feet in a very prolific fresh-water stratum.

Liberty Oil Company. No. 1 well of this company is Sulphur Mountain No. 1, the Liberty having under lease a portion of the latter company's land. No. 2 was abandoned in the current year, at a depth of 1453 feet, because of mechanical troubles brought about by excessive drilling difficulties.

Puritan Oil Company. Is drilling on northwest quarter of southeast quarter of section 22.

Atlanta Oil Company. Has just started to drill on Lot 6 of the same section.

The surface exposures on Sulphur Mountain are highly confusing, and, as the developments so far undertaken have thrown little light on underground conditions, these are still a matter of doubt. The writer's theory as to the structure of this very remarkable mountain is as follows:

Referring to Figure 13, there is sufficient evidence that the Aliso Cañon wells were drilled in a formation dipping south 20° east or thereabouts, and inclined at a considerable angle. It is also known that between the line where this formation crops (marked by a line of seepages) and the southern face of Sulphur Mountain, there is a strip of very much broken and contorted territory. The Thanksgiving well was evidently drilled in this fault zone, which amply explains why it was not a success, though it should probably have found a little oil.

On the steep southern face of Sulphur Mountain, which rises very sharply from the lower hills, all the exposures dip north and a little west, or, in other words, directly into the mountain, and just opposite to the dip at the Aliso wells. These exposures may be traced for a long distance east and west of section 22, and seem to characterize the entire ridge. A number of small seepages are found along the line of junction between these upturned strata and the lower fault material.

On the northern side of the mountain the exposures are much fewer, but at various places along the roads and in tunnels which have been driven into the northern face, the dip is uniformly south and a little east, and at an angle ranging from 20 degrees to 25 degrees to the horizon. A little farther to the north is again a belt of much disturbed territory,

the rocks being vertical in many places, and north of this line of disturbance the character of the rocks changes, and brown shales found in the body of the mountain giving place to whitish chalky shales.

These facts appear to determine that the main body of Sulphur Mountain is a "fault block," that is, an isolated strip of formation,

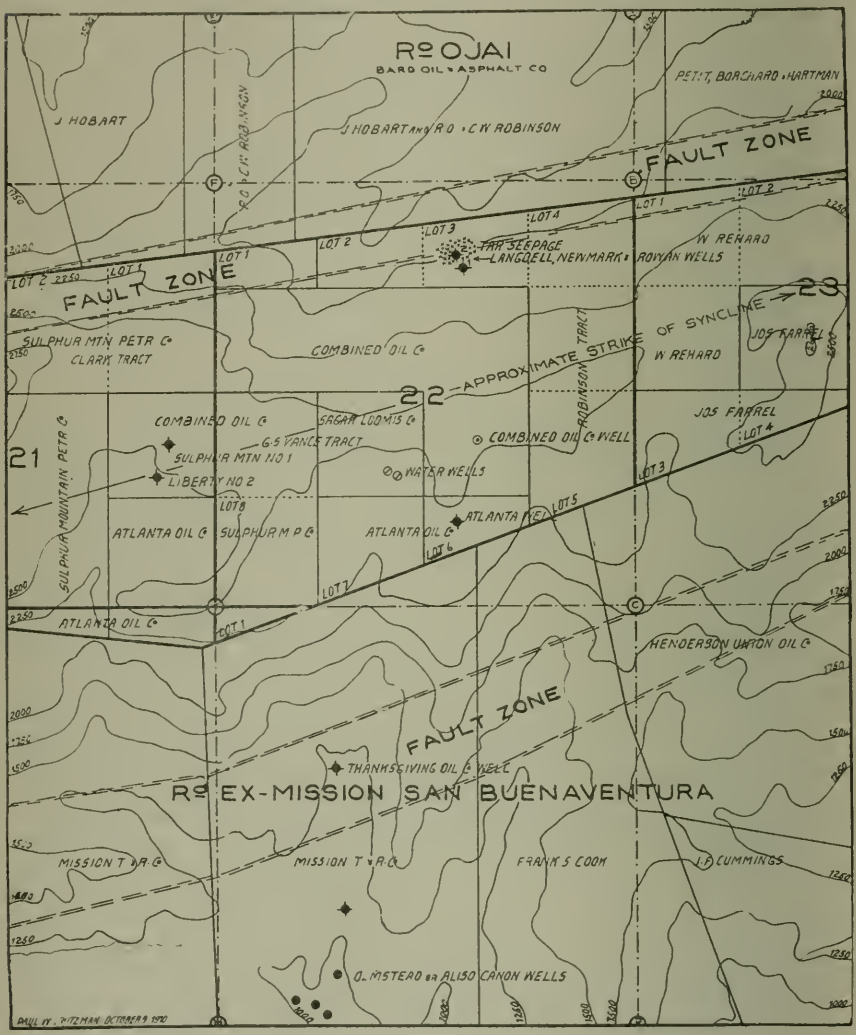


FIGURE 13. Showing locations of Sulphur Mountain Wells.

raised above the level of the surrounding rocks, and separated from them by strips of broken material. Whatever oil-producing formations may be found on Sulphur Mountain will, therefore, in all probability be found to be entirely separated from the producing strata north and south, except as small quantities of oil may seep across the fault zones.

They further determine that the body of the mountain is composed of two sets of strata dipping toward each other, and meeting along the line indicated on Figure 13 as "strike of syncline," either in a fault line, or in a curve or true syncline.

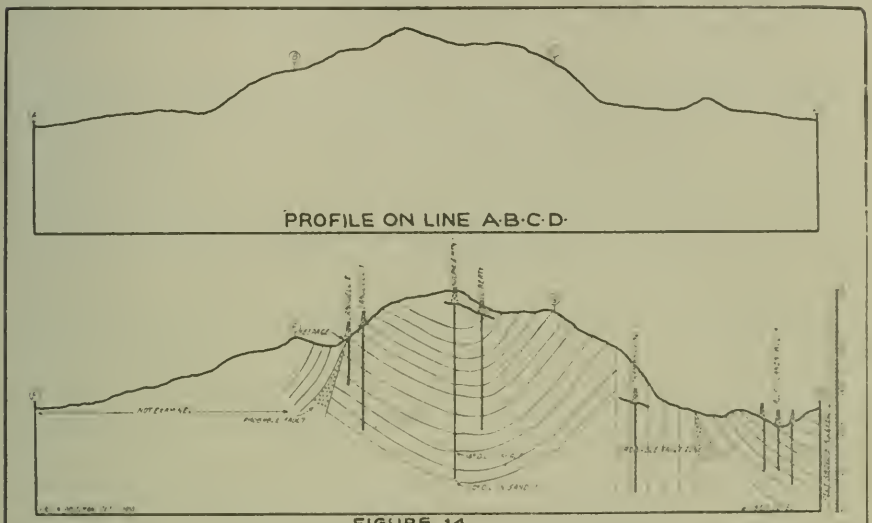


FIGURE 14
THEORETICAL GEOLOGICAL SECTION ACROSS SULPHUR MOUNTAIN ON LINE E·F·G·H· FIG·13

This question as to whether the inverted arch is or is not broken at its lowest point is difficult to determine, but is of the greatest importance. As, if it is broken, the probabilities are that the Sulphur Mountain well went into a pocket, and does not indicate any likelihood of profitable production from other wells in the same general neighborhood. While if the syncline is unbroken, there is every reason to believe that a strip of territory nearly a mile wide, and of indefinite length, will be productive.

I am of the opinion that the arch is unbroken, for the following reasons: First, that the parallelism between the north and south exposures is so true that, if a fault existed at the line where the two dips meet, this fault would of necessity be several miles in length. It seems incredible that a fault so extensive as this would not be marked, at some points at least, by contortions of the formation along this line, or at the very least by a series of east and west cañons, due to the superior erosiveness of the fault breccia. Neither are at all in evidence, the cañons (which are the best evidence in a country covered by deep soil) being of a north and south trend, with very shallow east and west branches, such as characterize erosion along the upturned edges of shales of varying hardness.

Further, in drilling the Sulphur Mountain hole, the drillers noted a constant drift to the south, and ascribe this to the dip of the hard streaks encountered at intervals. This condition is said to have persisted to the bottom of the hole, and determines that this well is still on the south dip, or, in other words, north of the apex of the synclinal arch, or of the fault.

In drilling the Liberty well, however, it was noted that there was no tendency whatever to drift in any direction (the drilling difficulties in this hole were principally casing troubles, due to excessive water, caving shale and very heavy tar streaks), and as the operators were expecting just this difficulty, and working under conditions which would have emphasized it, had it existed, we are safe in assuming that the formations encountered in drilling this well were lying practically horizontal. This also reduces the probability of a fault along the synclinal arch, as in the formation penetrated here, strongly characterized by hard shells, if the drill were passing through brecciated material there would be a very noticeable tendency to drift in various directions.

Passing the question of productiveness of the formations of Sulphur Mountain proper, which can not be determined with certainty from the data now available, we may note briefly the extent of territory to which the noted conditions apply. Referring to Figure 15, which is drawn to a uniform scale of one fourth of an inch to 100 feet, it will be noted that, assuming a dip of 20 degrees from the Langdell well No. 1 to Sulphur Mountain No. 1, and allowing for the difference in surface elevation, the heavy oil stratum found in Sulphur Mountain well at about 1800 feet should have been passed in the Langdell well at 460 feet, and the light oil found at about 2100 feet in the Sulphur Mountain well should have been found in the Langdell well at 800 feet. A report has been quoted, that a light oil layer was found at this depth in the Langdell well, but not sufficiently productive to make a well. This report is open to doubt,

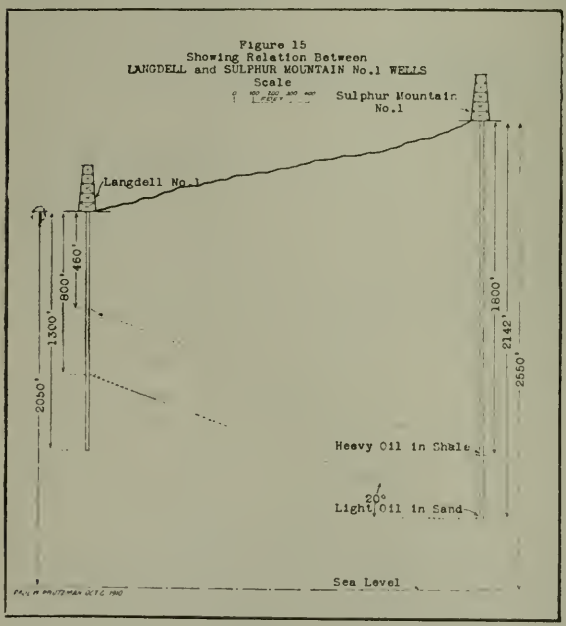


Figure 15
Showing Relation Between
LANGDELL and SULPHUR MOUNTAIN No.1 WELLS
Scale

from the Langdell well No. 1 to Sulphur Mountain No. 1, and allowing for the difference in surface elevation, the heavy oil stratum found in Sulphur Mountain well at about 1800 feet should have been passed in the Langdell well at 460 feet, and the light oil found at about 2100 feet in the Sulphur Mountain well should have been found in the Langdell well at 800 feet. A report has been quoted, that a light oil layer was found at this depth in the Langdell well, but not sufficiently productive to make a well. This report is open to doubt,

but the probability remains that, owing to the proximity of the fault line to the location of this well, the strata which would otherwise have been productive have been drained of their oil, locally at least. In fact, it is quite possible that the stratum which is productive in the Sulphur Mountain well is faulted away back (that is south) of the Langdell wells—the figure shows the fault plane as lying to the north of No. 1 well, but it is more than possible that the hole actually passed through this plane. In this case, the upper portion of the hole would be in broken material containing streaks of oil, but no productive strata, while the lower portion would pass through the light oil sand, in place, but drained of most of its oil. In brief, if any profitable production is to be found in these formations, the data probably warrant us in placing its northern limit a short distance south of the Langdell wells.

As to the southern limit—it undoubtedly lies north of the fault line shown on the lower part of Figure 14, and probably between this line and the northern limit of the Ex-Mission grant—we can hardly fix it more closely from present information. As to the east and west limits, we can be guided only by the unusual continuity of the formation in these directions—it appears to be unbroken from near the west line of townships 4–22 to, or nearly to, Santa Paula Creek.

No sample of Sulphur Mountain oil is now available, and but one analysis, and it can not be stated with certainty whether the sample from which this was made was from the lower (heavy oil) sand only, or from both sands. Considering the figures below, the presence of a notable per cent of volatile distillate in an oil of this gravity would, ordinarily at least, indicate a mixture of light and heavy oil, so it is probable that the well was drawing from both sands. The sample was taken while well was on the pump.

7119:

Sulphur Mountain Petroleum Company. Well No. 1.

Gravity	17.6° Beaumé
Viscosity at 60° F.	81.15 Redwood (water, 1)
Viscosity at 185° F.	2.65 Redwood (water, 1)
Flash point	Below 60° F., Abel-Pensky test
Sulfur	1.46 per cent
Thermal value	18,551 British thermal units

Distillation.

Sample of 200 c.c., distilled in glass without steam.

Below 212° F.	3.1 per cent	58.0° Beaumé
212 to 302°	4.8 per cent	50.7
302 to 392°	8.1 per cent	41.2°
392 to 482°	7.4 per cent	32.4
482 to 572°	28.8 per cent	28.8
572° to grade	20.0 per cent	20.5
Asphalt	25.0 per cent	Grade "D" (about)
Water and loss	2.8 per cent	
	100.0 per cent	

This corresponds, in round figures, to the following commercial analysis:

Gasoline	61° Beaumé	2 per cent
Distillate	52°	6 per cent
Kerosene	42°	8 per cent
Stove oil	34°	6 per cent
Fuel oil	28°	30 per cent
Lubricating stock	20.5°	20 per cent
Asphalt	Grade "D"	25 per cent
Losses	---	3 per cent
		100 per cent

Nothing can be said as to the quality of these products. The oil, however, must be reasonably stable, to give a 20.5° lubricating distillate from a glass still.

Lyon Cañon Wells.

Four wells have been drilled in Lyon Cañon, as follows:

Ojai Oil Company. On southeast quarter of southwest quarter, section 13, 4–23, on the south side of Lyon Cañon. This well was located immediately under a well-marked outcrop of dry oil sand, dipping to the north, and after passing the lower layers of this sand, which were not productive, was carried to a depth of 1500 feet without any further indications.

Olga-Ventura Oil Company. Three wells were drilled by this company, on land now held by the Income Oil Company, about a mile above the Ojai well, and on the same side of the cañon. No. 1 was drilled in 1901, to a depth of 1300 feet, and for a time pumped about ten barrels per day of moderately heavy oil. The production soon failed and the well was abandoned.

Notwithstanding the fact that the surface exposures indicate a rather gentle dip to the east, well No. 2, which was located a little farther up the cañon, went 2100 feet without finding any oil whatever. It flowed fresh water for a time, and encountered some gas at the bottom, indeed gas is still bubbling up through the water, which no longer flows. Well No. 3 was abandoned at something less than 400 feet in 1903.

The discovery in well No. 1 of this company, which is well authenticated, suggests the presence of oil somewhere in this neighborhood, a suggestion which is strengthened by several seepages further up the cañon. No data are available, however, from which to forecast the probability of commercially valuable oil sands, nor their location. While it can not be stated with certainty, it is probable that none of the wells of this group are located on the Sulphur Mountain syncline proper.

W. J. McMillan of Los Angeles has a well on Lot 4 of section 30, 4–22. This well was drilled about 1901, was carried to a depth of about 1000 feet, is reported to have found some oil, and was abandoned on account of water trouble.

Showing North Slope of Pirie Anticline, West Side Ventura River, Sturgis Ranch.

Exposure of Bituminized Shales, Hall Cañon, Ventura County.

Wells of the Ojai Group.

The following wells have been drilled in a group occupying a position on the divide between the Upper Ojai Valley and Sisar Cañon:

Santa Paula Oil Company. Two wells on the T. Thompson tract, No. 1 being located on Lot 1 of section 11, No. 2 somewhat to the northwest of this, on the southwest quarter of the northwest quarter. The first well is said to have been 500 feet deep, and to have found considerable water, but no oil; the second well to have been about the same depth, and to have been entirely dry—these wells were drilled in 1901, and the project was abandoned, it is reported, for financial reasons. Eldridge, however, states that the second well was somewhat deeper than the first, and continues, "It is reported that this yielded lighter oil than the southern well, and that the latter struck oil similar to that encountered in one of the Sobra Vista wells, which was too heavy to pump." This raises a very interesting question, as, if oil was actually found in these wells, which are undoubtedly on a northwest dip, there might be some hopes of an extension in this direction. It may be said that there are now no indications of the pumping of oil in the past, around either of these old wells, and it seems rather doubtful whether they were ever productive.

Ventura Oil Company, or Ventura Oil and Land Company. A well on the southeast quarter of the northwest quarter of section 11. Nothing can be learned regarding this well, which was apparently drilled many years ago.

Sobra Vista Oil Company. Four wells on Lot 2 of section 11. No. 3 was a spoiled hole at 300 feet. No. 1 was perforated at 750 feet, which was probably about its total depth, No. 4 was 375 feet deep, and No. 2 intermediate between 1 and 4. These wells were drilled in 1901 and 1902, and were still on the pump in 1903, but were abandoned soon thereafter, as the production fell away very rapidly. It is said that No. 4 was the best producer and gave the lightest oil, but as this was the actual state of affairs on the Whidden Double lease just north, it is impossible to now determine whether the report has been borrowed from that lease—it will be noted that the depths of the wells correspond on the two leases. The gravity of oil ranged from 11° to 13° Beaumé.

Whidden Double Oil Company. The five wells of this company were drilled near the center of section 11, No. 1 and No. 3 being near the south line of northwest quarter of northwest quarter, and Nos. 3, 4 and 5 on an east and west line just south of the center of the fractional section.

Well No. 1 was a dry hole at 1000 feet, at which depth it caved and was abandoned. No. 2, lying just to the east, was probably of a somewhat less depth, though this can not be determined with certainty.

Mr. Double stated to the writer in 1903 that neither of these wells obtained any oil whatever.

Well No. 3 was finished at 160 feet in 1900, was pumping 8 barrels per day in the latter part of 1903, and was abandoned during the next year. This well is again being operated by another company. The oil had a gravity when fresh of 11.8° Beaumé.

Well No. 4 was carried to a depth of 575 feet, and finished, so far as could be determined, in the same sand reached in No. 3. The gravity of the oil was 13.4° Beaumé, and the production was less than that of No. 3, and accompanied by much water.

Well No. 5 was drilled to a depth of 1005 feet, reaching the same sand, which, however, carried only traces of oil of a still higher gravity, and a great deal of water.

This lease is now operated by the Ojai Valley Petroleum Company.

Ojai Valley Petroleum Company. Has two wells near the center of section 11, and is also pumping No. 3 of the Whidden Double Oil Company. This company also operates a lease in the Kern River field.

Well No. 1 of this company is immediately to the north of Whidden Double No. 4, was drilled to a depth slightly in excess of 1200 feet, but is apparently producing from about the 500-foot level. This well is flowing about one barrel per day of 13° oil.

Well No. 2 was drilled in 1909, and is south of Whidden Double No. 4. The depth is 500 feet, and the well is a very small producer.

These records, slight as they are, seem to show very plainly the relationship of these wells. Just west of Whidden Double No. 3 is an outcrop of sandstone, dipping to the east, and a small brea bed. This is undoubtedly the sand from which these wells produce, and the depths and distances of the Whidden Double wells show a dip for this sand of about 46° to the horizon. The Sobra Vista wells do not follow the line of dip exactly, and the surface exposures are too small to check this figure, though the depths of the Sobra Vista wells agree with it in general.

The Canadian Queen well in the southeast quarter of the section reached the first sand somewhere about 1400 or 1500 feet, and as the dip shown at the Whidden Double wells would reach a depth of some 3000 feet in this distance, it follows that either the sands flatten considerably, in the intervening distance, or else that a different formation was penetrated in the Canadian Queen well. That the latter is the case is probable from two circumstances, one that the shallower wells on both the Whidden Double and Sobra Vista leases were the most prolific, the other, that lighter oil was reached in the deeper wells. Both of these facts would seem to indicate that these wells were drilled into a small fault block, the more porous layers of which had been bitumen-

ized by seepage from the west, and probably from deposits lying on the west dip, and at a greater depth. No drilling has ever been done on the west dip, by means of which this point could be determined, but, however this may be, the practical failure of the deeper wells to the east of this group, and the entire failure of those immediately to the north, bars any extensions in these directions, and there do not appear

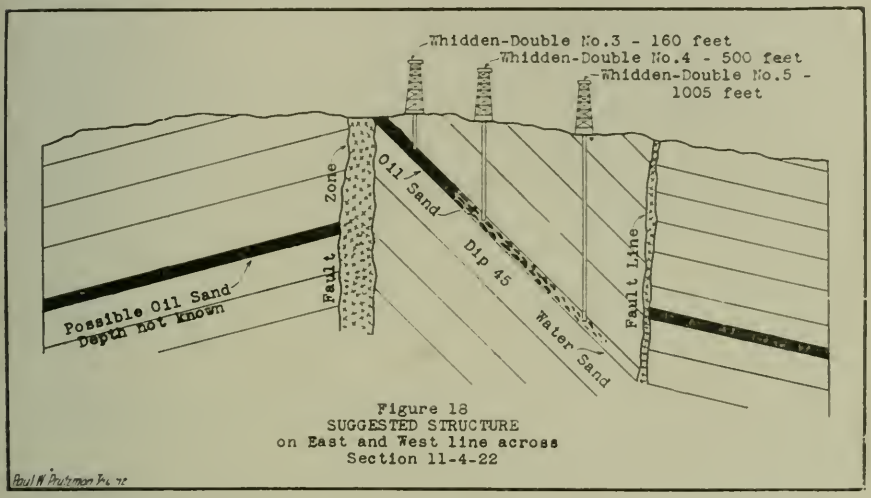


Figure 18
SUGGESTED STRUCTURE
on East and West line across
Section 11-4-22

to be any great prospects to the south. A well somewhere in the neighborhood of the old Santa Paula wells, but somewhat to the west, and carried to a considerably greater depth, would be an interesting experiment.

Gates Oil Company. The abandoned hole in the southwest corner of this property was probably drilled by the Chillicothe Oil and Mining Company in 1902. The depth is reported as about 700 feet, without a discovery. The well of the Gates Oil Company in the southeast corner of this property had not, when visited, reached a sufficient depth to be of interest.

Canadian Queen Oil Company. No information can be had as to the old abandoned well near the east line of this lease—it appears to be shallow. No. 1 of the Canadian Queen Oil Company was in what appeared to be a prolific oil sand at a depth of about 1500 feet, in the first part of 1911. So much water had been let into the hole that it was impossible to determine the value of the strike.

Canada West Oil Company. This company was drilling at the time, but had not reached the sands.

Ojai Oil Company. This company has three wells on the Davey and Bay tracts, in Lot 2 of section 12. No. 1 was drilled in 1907, to a depth of 1002 feet, and produces about 15 barrels. No. 2 was drilled in 1910

to 1250 feet, and is good for about 20 barrels. No. 3 was finished at the same depth in the latter part of 1910, and started off at 240 barrels per day; its present production is not known. The oil from these wells is about 15° gravity.

Santa Maria Crude Oil Company. Has a well on the Bay tract, in Lot 3 of the same section, started in 1910, and unfinished at last reports.

Bard Oil & Asphalt Company. This company has thirteen wells on a portion of the Rancho Ojai lying directly south of section 12. At the beginning of 1911, three of these wells were drilling, three abandoned, and seven producing. The records are as follows:

No. 21, drilled in 1907, depth 745 feet. This well produced 175 barrels the first day, but exhausted itself in about thirty days and was abandoned. This is the farthest south of any well in this group.

No. 22, lying immediately to the north of 21, was drilled in the same year to a depth of 600 feet. The reason for abandoning is not known, but it is generally understood to have been a very small producer.

No. 23 is the next well north, was drilled in the same year, and is still producing about 15 barrels per day.

No. 24 is one location north, and was drilled in 1908 to a depth of 2665 feet. No oil was found below the 800-foot level, and the well is now producing some 50 barrels from that depth.

No. 25 is one location farther north, was drilled in 1908, and is good for about the same amount at 915 feet.

No. 26 is in the same north and south line, and immediately south of the ranch line. It was drilled in 1909, and produces some 30 barrels from a depth of 1170 feet.

No. 27 is one location east of the above, was drilled in 1910 to a depth of 1318 feet, and is good for about 15 barrels per day.

No. 28 is one location west of 24, and was abandoned at 720 feet in 1910. This appears to have been practically a dry hole.

No. 29 is a location west of 26, and is good for 50 barrels a day at 1113 feet.

No. 30 lies midway between 28 and 29, and is good for about 30 barrels at 840 feet.

Nos. 31, 32, and 33 were drilling when last visited.

As the surface elevation over the area on which these wells are located is quite uniform, an examination of the depths above recorded throws some light on the dip of the producing strata. This, of course, assumes that the wells all penetrate the producing formation to the same depth, but while this is likely not to be strictly true, it is also probable that it is quite within the limits of accuracy of the deductions drawn.

It will be noted first, that the three wells to the south and southwest of the Bard group were failures, and, while no data is at hand as to two of these wells, it is highly probable, considering the presence of

extensive brea beds just to the south, that the formation is here disturbed by local faulting. How far this may extend can not be told.

Figuring from Bard No. 22 to No. 26, we find a dip of approximately 600 feet in some 1600 feet horizontal distance, or about 20 degrees to the north. The depth of the Ojai Oil Company's wells agrees with this. From Bard No. 29 to 27 the distance is about 1000 feet, and the dip slightly over 200 feet, but, on the other hand, from Ojai 1 to Ojai 2, a dip of 250 feet is shown in the opposite direction. The Canadian Queen well, still farther west, is about 400 feet deeper than Bard 29, which leaves two possibilities—first, that the Bard wells from 21 to 26 are along the crest of an anticline, plunging to the north, and dipping east and west—second, that the main dip is north, and that the variations in depth in an east and west direction are due, in part to local flexures in the formation, in part to different penetration into the sands. It is reported that the Queen well went farther into the sand that any well farther east; in fact, some think that it passed entirely through the oil-bearing layer. It is altogether probable that further developments will show the latter case to be the true one—that the main dip is to the north, and that the formation is more or less folded along axes parallel to the dip, the troughs of these folds being richer in oil than the higher portions. No limit is set as to the extensions to north and east, nor to the northwest up to the neighborhood of the Whidden Double wells.

The upper strata in this area is mainly clay and shale, differing in this from most of the productive ground in Ventura. For this reason, and because a great deal of water is encountered, drilling conditions here are rather difficult, and care is required. Differing from the Whidden Double wells, the oil from this pool is produced from material other than sand—the local drillers report that it is found in finely crushed shale of a brown color, and, while such a statement must be received with caution, it is highly probable that this oil is, like the lighter oils of Santa Maria, crevice oil, occurring in the joint cracks in more or less disturbed and broken shales.

Changes to March 15, 1912.

Since the above paragraphs were put into type, the following changes have been noted and corrections made:

Combined Oil Company. This is a combination of the Liberty Oil Company, the Puritan Oil Company, and the Atlanta Oil Company. The Puritan hole has been continued by the new company, and in February, 1912, was reported to be drilling at 1453 feet.

Puritan Oil Company. Now operating under the name Combined Oil Company, as noted above.

Atlanta Oil Company. This hole was abandoned during 1911 at a depth of about 800 feet. It is said to have been a crooked hole at some 500 feet.

Gates Oil Company. The well of this company on the Sturnam tract has been abandoned, at about 1200 feet. This well is reported to have gotten some fifteen barrels of oil, with a great deal of water immediately below. It is said that the oil sands pinch at this end of the field, but it appears more likely that this well was located at the feather edge of the water level, that is, where the top of the sloping sands were filled with oil, the lower part with water. This condition was strikingly illustrated in the Los Angeles City Field, where the southern limit of the field was set by water level.

Canadian Queen Oil Company. This company was pulling casing and preparing to abandon at the beginning of the current year. The depth had not been increased since last reports. It is said that this well passed from oil immediately into water, and was probably so far out on the dip that only the upper portion of the sands contained oil.

Canada West Oil Company. This well was suspended when visited, and it was reported as about to be abandoned. The depth reached was 1360 feet, and it is probable that conditions here were the same as at the foregoing.

Ojai Oil Company. This company was just finishing No. 4, at a depth of 1170 feet, in January, 1912. Corrected depth of No. 3 is given as 1185 feet.

Santa Maria Crude Oil Company. Well No. 1 was finished in the latter part of 1910, at a depth of 1285 feet, and is a small producer. No. 2 is a rig only, and is not to be drilled at present, while No. 3 is rigged and preparing to drill.

Bard Oil and Asphalt Company. Wells No. 31 and 32 were finished during 1911, and are pumping. No. 33 found very little oil, and much water, and was abandoned. No. 34 was drilling at about 400 feet in January, 1912. This well is in new territory, on lot 3 of section 18, 4–21·

Quality of the Oil.

The oil from the Ojai wells ranges from 11.8° to at least 18.8°, and possibly higher. The heaviest oils are from the wells to the west and south, the lightest from the wells farthest to the northeast. In this connection, the following gravities will be of interest:

An average sample from the Sobra Vista wells, taken in 1903, showed a gravity of 11.4°.

A sample from Whidden Double No. 3, taken in 1910 (well flowing), was of 13.9° gravity.

A sample from Bard No. 29, taken in 1910, showed the gravity 16.4°.

A sample from Bard No. 24, taken in 1910, showed the gravity 13.8°.

As will be shown by the following analyses, these appear to be normal oils for their gravity, of the usual brown to black color, and of mild odor. The heaviest are suitable for alphalt making only, or for fuel

when mixed with thinner oil. Those of medium grade resemble generally the oils of the San Joaquin Valley, but give rather larger yields of light products than an oil of the same gravity from the interior. A few oils give enough light products to render them fit for refining, for which purpose they are clean and easily worked. The following analyses completely cover the range of values:

7416.

Whidden Double Oil Company. Well No. 4.

Gravity ..... 13.4° Beaumé
Viscosity at 185° F. ..... 9.13 Redwood (water, 1)
Flash point ..... 133° F., Abel-Pensky test
Sulfur ..... 1.48 per cent by weight
Thermal value ..... 16,398 British thermal units

Distillation.

Sample of 200 c.c., distilled in glass, without steam.

Below 392° F.	6.0 per cent	42.4° Beaumé
392 to 482°	6.1 per cent	34.6°
482 to 572°	18.9 per cent	29.2°
572° to grade	30.8 per cent	27.0°
Asphalt	38.1 per cent	Grade "D" (about)
Loss	0.1 per cent	
	100.0 per cent	

This corresponds to the following commercial analysis:

Kerosene	42° Beaumé	6 per cent (value doubtful)
Stove oil	34°	7 per cent
Fuel distillate and lubricants		49 per cent
Asphalt		38 per cent
		100 per cent

The latter portions of the distillate are so thoroughly cracked as to give no idea of quantity or value of lubricants. The analysis below, however, gives some information as to this point. This is strictly an asphalt-making oil.

2494.

Whidden Double Oil Company. Wells Nos. 3 and 4, a mixture.

Gravity ..... 11.8° Beaumé

Distillation.

A small sample was distilled from an iron still, and the total distillate reduced with steam. This gives results roughly approximating practice.

Commercial analysis—

Fuel distillate	24° Beaumé	24 per cent
Reduced lubricants	17.5°	32 per cent
Asphalt	Grade "D"	42 per cent
Losses		2 per cent
		100 per cent

There was no distillate below 270° F., and therefore no kerosene. The total distillate from the first run averaged 24.7° Beaumé, which indicated that the oil is not unusually tender. The actual yield of asphalt

was 41.7 per cent by volume, equal to 44.4 per cent by weight, or 153 pounds, net, to the barrel of oil. This is strictly an asphalt oil, and gives an unusually large yield.

4444.

Bard Oil & Asphalt Company. Well No. 27.

Gravity ..... 17.9° Beaumé

Distillation.

A sample of 125 c.c., distilled in copper, first two cuts dry, latter cuts in a stream of inert gas.

First cut	7.2 per cent	52.7° Beaumé
Second cut	11.6 per cent	42.4°
Third cut	10.0 per cent	31.3°
Fourth cut	61.1 per cent	22.7°
Fixed carbon	10.1 per cent	
	100 per cent	

The carbon is calculated to the corresponding weight of "D" asphalt by the usual factor, and the last cut reduced with steam. This is roughly equal to the following commercial analysis:

Engine distillate	52° Beaumé	8 per cent	
Kerosene	42°	10 per cent	
Stove oil	34°	11 per cent	
Fuel distillate	28°	19 per cent	Slop distillate 22.7°–48°
Reduced lubricants		27 per cent	
Asphalt	Grade "D"	25 per cent	
		100 per cent	

The small quantity of light products from this oil is of fair quality only. The lubricating stock decomposed considerably, and the reduced lubricating stock, with a standard dose of acid, gave a deep ruby oil with fair, dull green outertone. This oil gives almost as large a yield of light products as 4442, but is less readily refined, and may be classed as a refining oil of second grade.

4442.

Ojai Oil Company. Well No. 1.

Gravity ..... 18.8° Beaumé

Distillation.

A sample of 150 c.c. was distilled in copper, as in 4444, and re-run and calculated in the same manner.

First cut	11.0 per cent	52.5° Beaumé
Second cut	8.0 per cent	40.6°
Third cut	8.3 per cent	32.4°
Fourth cut	63.4 per cent	22.5°
Fixed carbon	9.3 per cent	
	100 per cent	

This is equal to the following commercial analysis, in round figures:

Engine distillate	52°	Beaumé	11 per cent	
Kerosene	42°		7 per cent	
Stove oil	24°		9 per cent	
Fuel distillate	28°		18 per cent	Slop distillate 22.5°—50%
Reduced lubricants	14.2°		32 per cent	
Asphalt	Grade "D"		23 per cent	
			100 per cent	

On large scale distillation this oil might yield a little gasoline, with correspondingly less engine distillate. It is a clean, sweet oil, and runs readily. The light products are of mild odor, treat out readily to water white and sweet oils, and appear to be of first quality. The reduced lubricating stock, with 5 per cent acid, yields a beautiful cherry red oil, with fine green overtone, and appears to be of the best quality. This is a first grade refining oil, not giving a very large yield of light products, but very susceptible to treatment.

CHAPTER IV.

EX-MISSION, SILVERTHREAD AND EMPIRE WELLS.

Township 4-21.

The lack of information as to this township is so complete that it will hardly be possible to give more than a list of the developments, and a few scattering remarks as to their relations. This lack of data is due to the large holdings in this township of two corporations which refuse all information as to their operations, and while considerable pains have been taken to gather all the facts available, these are rarely sufficient to justify any broad, general conclusions.

The producing portion of this township is divided into four areas, as follows:

A strip along the northern margin of the Ex-Mission grant, and including (reading from east to west) the Slocum, Tar Flat, Adams Cañon, Saltmarsh Cañon Oil Company; and, in the next township, the Saltmarsh Cañon, Burrows or Wheeler Cañon, and Olmstead or Aliso Cañon wells. All these are the property of the Union Oil Company or its lessors.

A portion of the eastern end of the Rancho Ojai and of the surveyed land immediately north, covering wells of the Hilltop, Hillside Crude, Pyramid, and Capitol Crude Oil Companies, and the Bard Oil & Asphalt Company, and known collectively as the Silverthread group.

A small area in section 22, containing several wells originally known as the O'Hara, later the Golden West, wells, and now the property of the Paula Oil Company.

A strip along the southern boundary of sections 14 and 13, and extending into the next township, the property of the Empire Oil Company.

Several other portions of the township have been unsuccessfully prospected, and such work will be described in connection with the nearest production.

The Topa-Topa Mountains, foothills of the San Rafael Range, cross this township from west to east, and occupy the major part of the twelve most northerly sections. Santa Paula Creek rises in these mountains, and, flowing in a southwesterly direction, takes a southern trend in section 9, and thence flows south and a little east. Sisar Creek falls into Santa Paula Creek at the eastern end of Rancho Ojai, its narrow valley forming the eastern end of that ranch.

Sulphur Mountain crosses the western boundary of the township just south of Rancho Ojai, and, narrowing somewhat, terminates abruptly at Santa Paula Creek. South of this mountain, and west of the creek named, is a region of rather low, rolling hills, which extends almost

across the next township to the west (4–22) and reaches south, gradually declining in elevation, to Santa Clara River.

East of Santa Paula Creek the country is rougher, the hills merging imperceptibly into the Topa-Topa Mountains without any intervening valley as at the west, the surface having, as will be noted from the arrangement of the cañons, a general trend to the southwest.

Ex-Mission Wells.

These wells occupy a position near the upper edge of the formation south of Sulphur Mountain, and dipping toward Santa Clara River at a greater angle than the surface average. They are, of course, south of the main fault forming the southern boundary of Sulphur Mountain, and lie very much lower, being at an average height of, say, 1500 feet above sea-level, though elevation of single wells varies considerably in this rough country. The hills on which these wells are situated are, in the main, rounded, fairly accessible, grass-covered on the slopes, with brush and small timber in the cañons, and some good farming land in the small valleys.

Olmstead or Aliso Cañon wells. These wells are located on a small mesa, where Aliso Cañon branches north and south. They were drilled by the late Frank Olmstead in 1901 and 1902, and are five in number. No. 1, drilled in 1901, is said to have produced fifteen barrels per day for a time. No. 2 was only 350 feet deep, but is said to have flowed for several years, quantity not stated. No. 3 was a producer, as was No. 4, the latter 1500 feet deep, and a flowing well. No. 5 is reported as a dry hole, and deeper than 1500 feet. None of these wells are now being worked, though three are still equipped with pumping rig. The well farthest to the northeast and up the hill is flowing perhaps a barrel a day of oil described.

Thanksgiving Oil Company. The well of this company, in the center of the north half of section 26, 4–22, was drilled in 1910 by the Thanksgiving Oil Company of Los Angeles. It was carried to a depth of 600 feet, and is reported to have found only traces of oil—abandoned.

C. A. Burrows & Son—Henderson-Union Oil Company—Wheeler Cañon wells. The first of these wells was drilled by Hardison & Stewart, the founders of the Union Oil Company, in the early eighties, later wells by C. A. Burrows & Son of Santa Paula. The property, which is a lease from the Union Oil Company of California, has lately passed into the hands of E. E. Henderson of Los Angeles, and is being operated under the name of Henderson-Union Oil Company. These wells are located on the southwest corner of Lot 24 of the Elisio Tract, Rancho Ex-Mission, and mainly in the northwest quarter of section 25, 4–22. They are reached by a road up Wheeler Cañon from the main

Ventura road near Saticoy, and are found where this cañon forks at the foot of Sulphur Mountain. Nine wells and one tunnel are located east of the main cañon, one well and two tunnels up the northwest fork, two wells on the west side of the main cañon, and the old Wheeler, Trask & Coleman tunnel farther to the west, and in the west fork. Still farther up this cañon is a well-marked seepage of light oil.

So far as is known, there are thirteen wells on this tract, depths of but two of which are known. No. 5, drilled in 1902, is a producer at something over 600 feet. No. 6, drilled in 1903, is a producer at 958 feet. It is said that these wells all lie between 600 and 1000 feet in depth, and that the five producers are good for perhaps 1000 barrels per month in all. In the latter part of 1910, seven were abandoned, five producing, and one was being drilled by the new lessees.

There are also four tunnels on this property. The shallowest is the Wheeler, Trask & Coleman tunnel, in the west fork. This was dug in 1861, it is said, and was originally good for sixty barrels per day, though now making from two to three barrels. The Garrett tunnel, the farthest northwest, is 640 feet long, and is now producing about three barrels. This was dug in 1875. Both the others make some oil, but the lengths are unknown.

The effect of production from tunnels on the analysis of the oil is shown very plainly on comparing analyses 7412 and 7413. These oils are without doubt practically the same before production, and even as produced the gravity differs but one and one tenth degrees, yet the gasoline has entirely escaped from the tunnel oil, while that produced from No. 6 well gives a good yield.

Hardison & Stewart—Wheeler. An old well just east of the foregoing was drilled by Hardison & Stewart, the predecessors of the Union Oil Company. Abandoned—no data.

Red Rock Oil Company. The Red Rock Oil Company of Fillmore (not incorporated, Thos. Arundell, owner) drilled three wells just east of the Burrows wells in 1904. No. 1 was farthest to the south, and slightly below the line of strike of the formation in which the Burrows wells produce. This well was 1000 feet deep, and found a little light oil, but not enough to make a producer. No. 2 was farther to the north, and found only traces of oil to a depth of 600 feet. No. 3 was still farther north, and was carried only to 200 feet, where it got two or three barrels of heavy oil.

Farrell & Soule—Saltmarsh Cañon Oil Company. This group of wells is located in the north branch of Saltmarsh Cañon, and in the north half of section 30, 4–21.

The two earliest wells were drilled by Hardison & Stewart, about 1884. These wells are at the forks of the cañon, and some distance south

of the main group. One of these wells is said to have had some heavy oil at about 800 feet, but was abandoned because of caving ground. Nothing is known as to the other.

Well No. 1 of the Saltmarsh Cañon Oil Company was drilled by Farrell & Soule in 1901. This well was 249 feet deep, produced sixty barrels per day for a time, but fell away rapidly, and is now abandoned, as is No. 2. No. 3, drilled in 1903, is still producing two barrels per day at 280 feet. Nos. 4 and 5, drilled in the same year, are abandoned, as is No. 6, drilled in 1904 to a depth of 650 feet. No. 7, drilled in the same year, produces five barrels per day at 520 feet, while No. 8 is abandoned at 700 feet. No. 9 can not be found; No. 10 is recorded as abandoned. Well No. 11, drilled in 1906, produces one half barrel per day at 320 feet. No. 12 is 620 feet deep, was drilled in the next year, and produces four barrels. No. 13 was drilled in 1909, is 384 feet deep, and produces three barrels per day. No. 14 was drilled in 1910, and pumps a little oil at 315 feet.

Most of these wells are said to have been liberal producers when first drilled, but to have pumped out very rapidly. The total production of the lease at this time probably approximates five hundred barrels per month. Some of the oil from this cañon is of very peculiar quality, being of a strong green color, and very low in asphalt.

Union Oil Company—Saltmarsh. In the east branch of Saltmarsh Cañon, and at the foot of the divide between Saltmarsh and Adams cañons, the Union Oil Company formerly had a group of fourteen wells. This property is now under lease to the Midway Petroleum Company.

Well No. 1 was drilled in January, 1888, to a depth of 290 feet. It started off at 200 barrels per day, but at the end of a year had dropped to a daily production of 75 barrels. No. 2 was a crooked hole at 350 feet, and was abandoned.

Well No. 3 was 400 feet deep, and started off at 40 barrels per day, while No. 4, at the same depth, had an initial production of 55 barrels. No. 5 was 500 feet deep, and yielded but ten barrels per day.

Well No. 6 was carried to a depth of 1200 feet, and was a dry hole. No records can be found of later wells up to No. 11, but the group of wells drilled in this year (1888) included up to No. 9, at least.

Well No. 11 was drilled in 1897, and was a producer. This well was abandoned with the others when the lease was stripped, but has been cleaned and put to pumping by the lessees, and is now producing. No. 13 was drilled in 1898 to a depth of 2115 feet, and was a producer.

These wells appear to have been very short lived. During the first year the first nine wells are credited with a total average production of 200 barrels per day. In 1895 but three of these wells were being pumped, with a total output of some 300 barrels per month, or ten

barrels per day. In 1907 or 1908, after having stood idle for some time, this lease was completely stripped, and all the wells abandoned. It has since been leased to the Midway Petroleum Company.

Midway Petroleum Company. The property of this company is the old Saltmarsh lease of the Union Oil Company. This property was leased in 1908 to R. M. Boyer, who drilled one well, and also cleaned and put to pumping one of the old wells, Union No. 11. Later the lease and wells were sold to the Midway Company, who also drilled a well. This company, therefore, have three wells, as follows:

No. 11, drilled by the Union in 1897, a small producer at about 500 feet. No. 1, drilled by R. M. Boyer in 1909, said to be good for 8 barrels per day at 618 feet. No. 2, drilled by the Midway Petroleum Company in 1910, a small producer at about 800 feet. The oil from these wells is considerably heavier than the average of the Saltmarsh Cañon Oil Company's product, being a brownish oil of some 20° Beaumé.

Green Oil Mining Company. In 1902 this company drilled two wells in Adams Cañon, probably in the west branch. They also cleaned and pumped an old Union well, which was probably Adams No. 17–A, and this latter was reported at the time to be making fifty barrels per day. No. 1 was reported to be good for ten barrels of green oil, and No. 2 to be 140 feet deep, with some 33 degree green oil. These wells are now abandoned, and apparently were found, like the Saltmarsh wells, to be short lived.

Adams Cañon—Tar Flat wells. The wells in the three branches of Adams Cañon, occupying the south half of section 20, 4–21, are the property of the Union Oil Company of California, and appear to have been numbered as a single group, though the numbers are now greatly confused, and the numbers given on the map, while in the main believed to be correct, are probably not so in every instance. The data as to these wells, while very incomplete, are still more full than in any other part of the Ex-Mission country, and are given in full, as they throw some light on this interesting territory.

Well No. 1 was drilled about the year 1875, it is said, by Thayer, Adams & O'Hara. This well was drilled immediately on a small brea bed, to a depth of 180 feet, and in 1885, after having produced some ten years, was still doing from 20 to 25 barrels of oil daily. It is said, however, that after well No. 3 was drilled this well entirely ceased producing, at any rate it was abandoned before 1887.

Well No. 2 was the first well drilled by the Union Oil Company, and was put down in 1885, to a depth of about 200 feet. This was a dry hole. Well No. 3, at the same depth, was still producing 10 barrels per day in 1887. Well No. 4 was 500 feet deep, and was always a small producer, never more than 3 to 4 barrels per day. No. 5 was a dry hole

at 850 feet. Well No. 6 was 250 feet deep, and was good for from 2 to 3 barrels per day. All these wells were drilled in 1885.

The wells numbered from 7 to 12 were drilled in the following year. Well No. 7 found oil at 240 feet, and again at 390 feet. At the latter depth it flowed 75 barrels per day for a time, but in the following year was doing 50 barrels per day on the pump. This hole is said to have been later deepened to some 600 feet, but with what results is not known. The gravity of the oil was originally 28½° Beaumé.

Well No. 8 was the celebrated "Wild Bill" well. It found its first oil at 420 feet, and a second production at 735 feet, but was finished at 840, and later deepened to 970 feet. This well started off at 125 barrels per day, and maintained that production for at least a year.

Well No. 9 was drilled to a depth of 1261 feet. A small amount of heavy oil was found at 370 feet, but this was cased off, and as nothing was found below, the well was abandoned. No. 10, drilled to 625 feet, found water, but no oil, and was abandoned.

Well No. 11 was a dry hole at 1494 feet, and never produced. It will be noted that this well is on a straight line between Nos. 7 and 8, both producers, about half-way between them, and much deeper than either. This peculiarity was noted at a time when all these wells were operating, and the uncertainty which attaches to these old locations does not obtain in this case.

Well No. 12 was drilled to a depth of 440 feet, but it is said that top water was carried down, and though the well made a small amount of oil at times, it was never produced. No. 13 was drilled to 650 feet, and afterwards deepened to 780 feet. This well started off at 175 barrels per day, but afterwards increased its output. At the end of the first year it was reported to have made 74,000 barrels of oil, and to be still doing 220 barrels per day.

Well No. 14 was drilled in 1887. The depth was 300 feet, and it started off at 50 barrels daily. No. 15 was a dry hole at 1000 feet, and was abandoned.

Well No. 16 was probably the largest flowing well ever drilled in Ventura County. At a depth of 750 feet this well produced so heavily that the oil found its way down the long windings of the cañon and into Santa Clara River. After nine months it was still doing 500 barrels per day, but failed not long after, and was deepened to 1100 feet, but apparently without result.

Well No. 17 was drilled to 1400 feet, and kept on the pump for some time, but was a very small producer. The depth of No. 18 is not known, though it is over 900 feet.

Wells numbered from 19 to 24 were drilled in 1888. No. 19 was 1430 feet deep, and started off at 15 barrels per day. No. 20 was 900 feet deep, and had an initial production of 25 barrels. No. 21 was 860

feet, 60 barrels daily. No. 22 was 1400 feet, 20 barrels per day. No. 23 was 350 feet deep, and made 30 barrels per day. No. 24, which was located close to No. 16, was 1210 feet deep, and started off at 150 barrels per day. No. 25 got the first sand at 1980 feet, and was finished at 2450 feet. No. 27 was finished at 2780 feet. Well No. 3A, drilled in 1890, was a dry hole at 2550 feet, and never produced. Well No. 28 was 850 feet deep, and yielded 25 barrels per day until No. 29 was finished, when it went dry. Well No. 29 was 950 feet deep, and produced 60 barrels at first, then 25 barrels per day for five years.

In June, 1895, it is reported that there were 29 wells on this lease, of which but three were being pumped, these yielding about 900 barrels per month total. At least five wells, and possibly six, were drilled later, but little is known as to these. No. 31 was drilled in 1898, and was 2723 feet deep. No. 32, in the same year, was finished at 1817 feet. No. 34, drilled in 1899, was 1840 feet deep.

In January, 1912, when visited, this lease was not operating, but appeared to be temporarily shut down. One well was flowing, and eight were rigged with jack. The present production of the lease is not known, but is probably unimportant.

The wells in the eastern branch of Adams Cañon were known locally as the Tar Flat wells. These are included in the above, the divide between the two branches of the cañon being slight, and the numbering common to the two groups.

Feldt, B. W. The well located northwest of Adams No. 1, and well up on Sulphur Mountain, is said to have been drilled in 1879, and was known at the time as the "green oil well." This well was 182 feet deep, and originally produced some 40 barrels daily of a bright green oil, probably the same oil as is now found in some of the Saltmarsh Cañon Oil Company's wells. In 1887 the product of this well had fallen to 6 barrels per day, and it has long been abandoned.

Scott & Gilmore—Slocum Bros.—Forest City National Oil Company. The group of wells on the west side of Santa Paula Cañon, on lots A and S of Rancho Ex-Mission, have passed through several ownerships, and the reports concerning them are somewhat confused. The first seven wells appear to have been drilled by Scott & Gillmore, on a lease from the Union Oil Company, and to have reverted, with the lease, to the owners of the land. In 1895 these seven wells were reported to be producing about 100 barrels per month in all, and to be from 300 to 1100 feet deep.

The lease afterward passed to Slocum Brothers, of Santa Paula, and in 1910 was sold to the Forest City National Oil Company, who drilled one well, No. 16.

In January of the current year, thirteen wells were producing on this

lease, all on the jack, while three are known to have been abandoned, the latter being Nos. 2, 8, and 9. The depths of the producing wells, so far as known, are as follows: No. 1, 550 feet; No. 3, 160 feet; No. 5, 1400 feet deep, but producing from 780 feet—this well gives a black oil; No. 6, 600 feet; No. 7, 450 feet; No. 10, 500 feet; No. 11, 630 feet; No. 12, 543 feet; No. 13, 520 feet; No. 14, 660 feet; No. 15, 590 feet; these are all tubing depths as operated at present, the original depths are not known. No. 16, drilled in 1910, is 717 feet deep. These wells are all very small producers, but are pumped on the jack and are easy to maintain.

Hamilton Gardner Oil Company—Midway Provident Oil Company. A short distance to the southeast of the foregoing is the well of the Midway Provident Oil Company. This well was started by the Hamilton Gardner Oil Company in 1910. It is suspended at present, at some 500 feet.

Uncle John Oil Company. The only attempt, so far as is known, to find oil in this hill range outside of the narrow belt along the foot of Sulphur Mountain was made by the Uncle John Oil Company of Whittier. In 1901 and 1902 this company drilled two wells on the Sexton Ranch, northwest quarter of the northeast quarter, section 19, 3–22, on the east side of Sexton Cañon. No definite information can be had regarding these wells, which are said to have had a little oil at somewhere about 1000 feet.

The Ex-Mission country, as a whole, is credited with 30 producing wells, 67 abandoned (probably more than this), and 5 drilling in August, 1910. The oil produced varies somewhat, but is all of a high grade, and is found in streaks of hard sand, dipping steeply and regularly to the north. There are evidently several producing sands, and it is probable that the limit of development has been by no means reached. As a rule, the production of individual wells is small, but they are long lived, drilling is cheap and easy, and the country is favorable to operations.

QUALITY OF THE EX-MISSION OILS.

The oils of the Ex-Mission group are of unusual interest, and we are fortunate in having a thoroughly representative selection of analyses. While, with one exception, all the oils tested come above the limit usually fixed for refining oils, they show the most remarkable diversity of qualities, and afford a striking example of the axiom that neither the color nor the gravity of a crude gives more than the most tentative indication of its value to the refiner.

In color, these oils have a very wide range, shading from black of an unusual brilliance and opacity to a full, rich green, through greenish

black, brownish green and olive. The characteristic brown-black color of Midway and Kern River oils is lacking; the darkest of the green oils, however, show much the same shade as the top sand oils of the East Side, Coalinga.

Contrary to the usual supposition, the green oils are of much less value for refining purposes than the black. These green oils are of very unusual composition, resembling but one other oil produced in this State—that from section 20, 19–15, in Coalinga. It will be recalled that this oil, having a gravity of about 33° Beaumé, gives no gasoline and very little asphalt, some 52° distillate, a little kerosene of high boiling point, with a very large amount of 33° and 28° distillate, and finally a lubricating stock of slight viscosity. These characteristics are somewhat less pronounced in the green oils of the Ex-Mission, nevertheless the oils of this color are noticeably inferior to the black oils of the same gravity in giving less light distillates and valuable lubricants, and more middle distillate and lubricants of low viscosity.

These characteristics are plainly brought out in the appended analyses, and it is needless to go into details here. Comparison of a few of the analyses of green and black oils of the same gravity and of green oils of different gravities will be of interest, even if it does not throw any light on the nature and origin of these peculiar mixtures. In the present state of our knowledge of the hydrocarbons of which our oils are composed, it is useless to speculate on the source of these green oils, which occur in close proximity to others of a quite different quality, and often in the same well.

4484.*

C. A. Burrows & Son. Well No. 2.

Gravity ..... 20.0° Beaumé

This is a moderately limpid oil of a very black color, with mild and rather flat odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a stream of inert gas. Distillation carried to dryness.

First cut	7.2 per cent	49.0° Beaumé
Second cut	5.8 per cent	42.1°
Third cut	18.1 per cent	32.7°
Fourth cut	60.3 per cent	23.6°
Fixed carbon	8.6 grams per 100 c.c. oil.	
	100.0	

*Analysis by J. P. P.

The carbon is calculated to the corresponding weight of "D" asphalt by the usual factor, and the last cut reduced in a stream of gas. The above figures are roughly equal to the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	5.0 per cent
Kerosene	42.0°	10.0 per cent
Stove oil	33.0°	14.0 per cent
Fuel distillate	30.0°	26.5 per cent } Slop distillate
Reduced stock	15.4°	23.0 per cent } 23.6°—49.5%
Asphalt	"D"	21.5 per cent or 76 lbs. per bbl.
		100.0 per cent

The light products from this oil refine very well, to good colors and odors. The lubricating stock is very stable, and gives a fair yield of redueed stock of high viscosity and good color, which treats out with the standard dose of acid to a very handsome red oil of 18.6° gravity.

This is more nearly a normal oil than the green oils of this region, and it will be noted that a high asphalt percentage and low gravity go with a very fair yield of light oils, while the middlings are low.

7412.*

C. A. Burrows & Son. Well No. 6.

Gravity	27.2° Beaumé
Viscosity at 60° F.	2.79 Redwood (water, 1)
Viscosity at 185° F.	1.24 Redwood (water, 1)
Flash point	Below 60° F., Abel-Pensky test
Sulfur	0.72 per cent by weight
Thermal value	19,161 British thermal units

Distillation.

Sample of 200 c.c., distilled in glass, without steam.

Below 212° F.	12.8 per cent	70.4° Beaumé
212 to 302°	13.8 per cent	54.1°
302 to 392°	9.9 per cent	45.0°
392 to 482°	7.7 per cent	35.3°
482 to 572°	9.8 per cent	28.5°
572° to grade	30.0 per cent	26.9°
Asphalt	14.8 per cent	Grade "D" (about)
Loss	1.2 per cent	
	100.0 per cent	

This is approximately equal to the following commercial analysis:

Gasoline	61° Beaumé	27 per cent
Engine distillate	52°	None
Kerosene	42°	13 per cent
Stove oil	33°	5 per cent
Fuel distillate and lubricants		39 per cent
Asphalt		15 per cent
Loss		1 per cent
		100 per cent

*Analysis by H. N. Cooper.

This is a very unusual oil in point of gasoline yield, the gasoline starting so high as to include all the stock ordinarily going into a 52° cut. Middlings are low. It is impossible to speak with certainty as to the quality of the lubricating stock from figures quoted, but probably it is not of much value.

7410.*

Union Oil Company of California. Saltmarsh No. 11.

Gravity ---------- 19.7° Beaumé
Viscosity at 60° F. ---------- 31.82 Redwood (water, 1)
Viscosity at 180° F. ---------- 1.98 Redwood (water, 1)
Flash point ---------- Below 60° F., Abel-Pensky test

Distillation.

Sample of 200 c.c., distilled from glass flask, without steam or gas.

Below 212° F.	1.4 per cent	63.4° Beaumé
212 to 302°	8.7 per cent	53.6°
302 to 392°	8.3 per cent	42.8°
392 to 482°	8.7 per cent	33.2°
482 to 572°	8.9 per cent	26.2°
572 to grade	40.1 per cent	22.9°
Asphalt	20.7 per cent	Grade "D" (about)
Loss	3.2 per cent	
	100.0 per cent	

This is approximately equal to the following commercial analysis:

Gasoline	61.0° Beaumé	3 per cent
Engine distillate	52.0°	7 per cent
Kerosene	42.0°	9 per cent
Stove oil	33.0°	8 per cent
Fuel distillate and lubricants	23.5°	49 per cent
Asphalt	"D"	21 per cent
Loss	---	3 per cent
		100 per cent

This is a very unusual oil for this section, giving large yields at the ends, and small yields of middlings. It will be noted that a low gravity goes with a considerable yield of light products, much asphalt, and a heavy lubricating stock. The latter seems to distil without much breaking down.

4482.*

Union Oil Company of California. Saltmarsh No. 7.

Gravity ---------- 29.8° Beaumé

This is a very thin oil, with an olive green color, and sweet, rather gassy odor.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, fifth cut in a stream of inert gas. Distillation carried to dry coke.

First cut	5.6 per cent	56.6° Beaumé
Second cut	8.6 per cent	52.6°
Third cut	14.7 per cent	42.4°
Fourth cut	23.0 per cent	33.4°
Fifth cut	45.1 per cent	25.3°
Fixed carbon	3.0 grams per 100 c.c. oil	
	100.0 per cent	

*Analysis by J. P. P.

The carbon is calculated to "D" asphalt and the last cut reduced, as in the last analysis quoted. The above figures are equivalent to the following commercial analysis, the percentage given for the first and second products being approximate only:

Gasoline	61.0° Beaumé	2 per cent	
Engine distillate	52.0°	14 per cent	
Kerosene	42.0	13 per cent	
Stove oil	33.0	23 per cent	
Fuel distillate	31.5°	17 per cent	Slop distillate
Reduced stock	19.9°	23.5 per cent	25.3°—40.5%
Asphalt	---	7.5 per cent or 26 lbs. per bbl.	
		100.0 per cent	

The light products treated readily to good colors, and gave sweet refined products. The light end of the oil is of excellent quality, though the yields are very low for an oil of this gravity.

The heavy end of the oil was abused in the distillation and more decomposed than it should have been, still it is evidently not very stable. The reduced stock with the usual dose of acid gave a 21.7° red oil of fine color, but low viscosity.

4437.*

Midway Petroleum Company. Well No. 2.

Gravity ---------- 19.4° Beaumé

This is a moderately viscous oil, of a greenish black color and mild odor.

Distillation.

A sample of 150 c.c., distilled in copper, first three cuts dry, last cut in a current of gas. Distillation to dryness.

First cut	8.0 per cent	52.4° Beaumé
Second cut	8.8 per cent	42.4°
Third cut	10.5 per cent	33.2°
Fourth cut	64.7 per cent	22.5°
Fixed carbon	8.0 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor. Lubricating stock reduced in a stream of gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	8 per cent	
Kerosene	42.0°	9 per cent	
Stove oil	33.0	10 per cent	
Fuel distillate	29.0°	23 per cent	Slop distillate
Reduced stock	14.8°	20 per cent	22.5°—53%
Asphalt	"D"	20 per cent or 72 lbs. per bbl.	
		100 per cent	

The lighter oils from this crude refine readily to good colors and odors. The lubricating stock is stable, and gives a good yield of reduced stock of low gravity and high viscosity. This treats out with the usual

*Analysis by J. P. P.

dose of acid to a red oil of 17.3° gravity and an excellent color. This oil shows a surprisingly good analysis for its gravity, and may be considered a very good refining oil.

4435.*

Saltmarsh Cañon Oil Company. Well No. 14.

Gravity ---------- 22.3° Beaumé

This is a moderately thin oil of a strong green color and flat odor.

Distillation.

Sample of 150 c.c., distilled from copper in a stream of fixed gas, to a residue of dry coke.

First cut	18.8 per cent	33.0° Beaumé
Second cut	79.2 per cent	23.0°
Fixed carbon	2.0 grams per 100 c.c. oil	
	100.0 per cent	

Coke calculated to asphalt by the usual factor, and last cut reduced in gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	None
Kerosene	42.0°	None
Stove distillate	33.0°	19 per cent
Fuel distillate	30.0°	30 per cent } Slop distillate
Reduced stock	17.7°	46 per cent } 23.0°—76%
Asphalt	"D"	5 per cent or 18 lbs. per bbl.
		100 per cent

The light products from this oil are rather dark in color, but sweet and treated out well. The heavy stock was of good quality, and gives a large yield of reduced stock of fair viscosity. This, with the usual dose of acid, gives a 19.8° engine oil of very dark color and rather low viscosity.

The lubricating fractions of this oil are unusually refractory, and in spite of the handsome appearance of the crude it is of very little refining value.

2475.†

Saltmarsh Cañon Oil Company. Wells Nos. 1 and 6.

Gravity ---------- 25.2° Beaumé

This is a limpid oil of a deep olive color and mild odor.

Distillation.

Sample of 100 c.c., distilled from glass, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor X 0.8) for oxidation during evaporation. The original figures are:

Below 212° F.	1.5 per cent }	Gravity 53.7° Beaumé
212 to 302° F.	11.0 per cent }	
302 to 518° F.	25.5 per cent	37.6°
Residue above 518°	62.0 per cent	20.7°

The high gravity of this residue is abnormal, and indicates a large percentage of the lighter lubricants. In this connection see Analyses

*Analysis by P. W. P.
†Analysis by E. N. Moor.

4482, 4439, 4461, and 4435. After evaporation to asphalt and calculation, the above figures are approximately equal to the following commercial analysis:

Gasoline	61° Beaumé	3 per cent
Engine distillate	52°	9 per cent
Kerosene	42°	18 per cent
Stove oil and lubricants	Not separated	60 per cent
Asphalt	---	10 per cent or 35 lbs. per bbl.
		100 per cent

4439.*

Saltmarsh Cañon Oil Company. Average of Wells Nos. 3, 11, and 13.

Gravity ---------- 25.9° Beaumé

This is a limpid oil, with a strong olive green color and a rather flat odor.

Distillation.

A sample of 150 c.c., distilled from copper, first two cuts dry, third cut in a stream of inert gas. Distilled to dryness.

First cut	9.2 per cent	42.2° Beaumé
Second cut	39.1 per cent	33.1°
Third cut	49.0 per cent	22.9°
Fixed carbon	2.2 grams per 100 c.c. oil	
	100.0	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of gas. The above figures are equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	None
Kerosene	42.0°	9.0 per cent
Stove oil	33.0°	40.0 per cent
Fuel distillate	32.0°	11.0 per cent / Slop distillate
Reduced stock	18.6°	34.5 per cent \ 22.9°—45.5%
Asphalt	"D"	5.5 per cent or 19 lbs. per bbl.
		100.0 per cent

Light products refine readily. Stove oil was considerably decomposed, and the high yield of this product is in part due to breaking down of the heavy lubricating oils, though distillation was conducted under favorable conditions. The lubricating stock was, therefore, a good deal burned, and gave a bluish reduced stock of low viscosity, which with the usual dose of acid gave a 20° engine oil of fair color only.

A small amount of 52° distillate may have escaped estimation in this test, but the yield, if any, must be extremely small. The high yield of middlings makes the gravity of this oil very deceptive, as the analysis shows it to be of little refining value.

*Analysis by J. P. P.

5461.*.

Saltmarsh Cañon Oil Company. Well No. 12.

Gravity ---------- 29.8° Beaumé

This is a limpid oil of a strong green color and flat, rather foul odor, resembling that of the seepage oil of Sulphur Creek, Colusa County.

Distillation.

A sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a current of fixed gas. Distillation carried to dry coke.

First cut	14.9 per cent	52.2° Beaumé
Second cut	18.3 per cent	42.6°
Third cut	25.6 per cent	33.2°
Fourth cut	39.7 per cent	24.6°
Fixed carbon	1.5 grams per 100 c.c. oil	
	100.0 per cent	

Coke calculated to asphalt by the usual factor, and the last cut reduced in a current of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	15.0 per cent	
Kerosene	42.0°	19.0 per cent	
Stove oil	33.0°	25.0 per cent	
Fuel distillate	27.5°	15.6 per cent	Slop distillate
Reduced stock	19.9°	21.6 per cent	24.6°—37.2%
Asphalt	"D"	3.8 per cent or 13 lbs. per bbl.	
		100.0 per cent	

The light products from this oil are of good and sweet odor, but do not readily treat to water-white oils. The stove oil is sweet, and the large yield seems to be natural to the oil, and not the result of decomposition. The lubricating stock is of fair color and low viscosity, and gives a normal reduced stock, which treats out to a red oil of a dark amber color and rather low viscosity.

5466.*

Saltmarsh Cañon Oil Company. Well No. 7.

Gravity ---------- 32.7° Beaumé

This is a very limpid oil, with a strong green color and a flat, repulsive odor.

Distillation.

Sample of 100 c.c., distilled from copper, first four cuts dry, fifth cut in a current of gas. Distillation carried to dryness.

First cut	7.5 per cent	61.5° Beaumé
Second cut	14.0 per cent	52.7°
Third cut	9.5 per cent	42.9°
Fourth cut	35.5 per cent	32.9°
Fifth cut	32.1 per cent	21.4°
Fixed carbon	1.4 grams per 100 c.c. oil	
	100.0 per cent	

The carbon is calculated to asphalt by the usual factor, and the fifth

*Analysis by P. W. P.

cut reduced in a current of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	8.5 per cent
Engine distillate	52.0°	13.0 per cent
Kerosene	42.0°	11.0 per cent
Stove oil	33.0°	32.5 per cent
Fuel distillate	29.0°	13.3 per cent / Slop distillate
Reduced stock	16.2°	18.2 per cent \ 21.4°—31.5%
Asphalt	"D"	3.5 per cent or 12 lbs. per bbl.
		100.0 per cent

The light oils from this crude refine with unusual readiness to water white oils of very slight odor. The stove oil shows little indications of cracking. The lubricating stock is of good color and viscosity, and gives a reduced stock of excellent color. This treats out to a fine red oil of high viscosity.

7409.*

Union Oil Company of California. Adams Cañon, Green Oil Tunnel.

Gravity	20.1° Beaumé
Viscosity at 60° F.	8.95 Redwood (water, 1)
Viscosity at 180° F.	1.40 Redwood (water, 1)
Flash point	154° F., Abel-Pensky test
Sulfur	0.32 per cent by weight
Thermal value	19,087 British thermal units

Distillation.

Sample of 200 c.c., distilled from glass without steam or gas.

Below 302° F.	0.8 per cent	
302 to 392°	7.8 per cent	43.3° Beaumé
392 to 482°	16.3 per cent	37.2°
482 to 572°	17.4 per cent	30.6°
572° to grade	40.0 per cent	25.3°
Asphalt	16.6 per cent	Grade "D" (about)
Loss	1.1 per cent	
	100.0 per cent	

This is roughly equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	1 per cent
Kerosene	42.0°	9 per cent
Stove oil	33.0°	32 per cent
Fuel distillate and lubricants	28.3°	40 per cent (not separated)
Asphalt	"D"	17 per cent
Loss	---	1 per cent
		100 per cent

The heavy end of this oil holds up better in distillation than in No. 7408, but, as usual, the middle cuts are very large.

*Analysis by H. N. Cooper.

4486.*

Union Oil Company of California. Adams Cañon average.

Gravity ---------- 25.1° Beaumé

This is a limpid oil of a very black color, with mild, gassy odor.

Distillation.

Sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a stream of inert gas. Distillation to dry coke.

First cut	5.6 per cent	60.0° Beaumé
Second cut	5.6 per cent	51.5°
Third cut	9.0 per cent	42.4°
Fourth cut	22.8 per cent	33.1°
Fifth cut	51.7 per cent	25.3°
Fixed carbon	5.3 grams per 100 c.c. oil	
	100.0 per cent	

Coke is calculated to asphalt by the usual factor. Fifth cut reduced in a current of gas. Following is the commercial analysis:

Gasoline	61.0° Beaumé	5.0 per cent	
Engine distillate	52.0°	6.0 per cent	
Kerosene	42.0°	9.0 per cent	
Stove oil	33.0°	23.0 per cent	
Fuel distillate	32.0°	18.0 per cent	Slop distillate
Reduced stock	18.6°	25.7 per cent	25.3°—43.7%
Asphalt	"D"	13.3 per cent or 47 lbs. per bbl.	
		100.0 per cent	

The light products are of first quality and refine readily. The lubricating stock breaks down considerably, and gives only a low yield of reduced stock. This treats with five per cent of acid to a 20.7° red oil of low viscosity and rather brownish red shade. Considerable paraffin occurs in this fraction, giving the red oil a high cold test.

This oil is rather high is middlings and low in end products, and is not very stable at the latter end.

4485.*

Union Oil Company of California. Adams Cañon, H. & S. Tunnel No. 1.

Gravity ---------- 25.2° Beaumé

This is a very limpid, clear oil, of a strong green color and mild, gassy odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, fourth cut in a current of gas. Distillation carried to dry coke.

First cut	5.4 per cent	52.2° Beaumé
Second cut	12.9 per cent	42.6°
Third cut	25.4 per cent	33.1°
Fourth cut	52.5 per cent	21.2°
Fixed carbon	3.8 grams per 100 c.c. oil	
	100.0 per cent	

*Analysis by J. P. P.

Carbon calculated to asphalt in the usual manner. Fourth cut reduced in a stream of inert gas. The following is the commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	6 per cent	
Kerosene	42.0°	13 per cent	
Stove oil	33.0°	25 per cent	
Fuel distillate	28.0°	14 per cent	Slop distillate
Reduced stock	17.1°	32 per cent	21.2°—46.5%
Asphalt	"D"	10 per cent or 32 lbs. per bbl.	
		100 per cent	

As is usual with tunnel oils, gasoline is absent. Distillate and kerosene are sweet and treat out freely. The lubricating stock holds up well, both in distillation and reduction, and has a good viscosity. Reduced stock treats with standard dose of acid to a good red oil with fair outertone, gravity 19.9°. The high gravity of the crude is due to low asphalt percentage and large amount of middlings, which do not appear to be due to decomposition of the lubricating stock.

4475.*

Union Oil Company of California. A well in Adams Cañon.

Gravity ..... 25.5° Beaumé

This is a limpid oil, extremely black and opaque, and with a mild and rather gassy odor.

Distillation.

A sample of 150 c.c., distilled in copper, first four cuts dry, last cut in a stream of inert gas. Distillation carried to dry coke.

First cut	5.8 per cent	57.5° Beaumé
Second cut	5.5 per cent	51.0°
Third cut	10.6 per cent	42.4°
Fourth cut	17.5 per cent	33.1°
Fifth cut	54.5 per cent	27.0°
Fixed carbon	6.1 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor. Lubricating stock not fractionated in this analysis. The following commercial analysis is indicated:

Gasoline	61.0° Beaumé	3 per cent
Engine distillate	52.0°	9 per cent
Kerosene	42.0°	10 per cent
Stove oil	33.0°	17 per cent
Fuel distillate and lubricants	27.0°	46 per cent (not separated)
Asphalt	"D"	15 per cent or 54 lbs. per bbl.
		100 per cent

The light products were of mild color and odor, and treated out well. Heavy stock badly cracked and of little value. Like the Tar Flat oil, this oil is best at its light end, the lubricating stock being too tender to be of much value.

*Analysis by J. P. P.

7408.*

Union Oil Company of California. Adams Cañon No. 27.

Gravity	28.9° Beaumé
Viscosity at 60° F.	5.91 Redwood (water, 1)
Viscosity at 180° F.	1.34 Redwood (water, 1)
Flash point	Below 60° F., Abel-Pensky test
Sulfur	0.48 per cent by weight
Thermal value	19,165 British thermal units

Distillation.

Sample of 200 c.c., distilled from a glass flask, last fractions being considerably decomposed. Light cuts read directly by picnometer weights. Asphalt determined by weight, no definite hardness stated. The original figures are:

Below 212° F.	4.0 per cent	63.2° Beaumé
212 to 302°	14.1 per cent	51.0°
302 to 392°	9.1 per cent	42.3°
392 to 482°	9.3 per cent	37.2°
482 to 572°	10.1 per cent	33.9°
572° to grade	43.0 per cent	29.4°
Asphalt	9.8 per cent	Grade "D" (about)
Loss	0.6 per cent	
	100.0 per cent	

This is roughly equivalent to the following commercial analysis. The percentage of stove oil is very doubtful, and may be much larger than as stated, but as this is of little value, the point is not of importance.

Gasoline	61.0° Beaumé	7 per cent
Engine distillate	52.0°	7 per cent
Kerosene	42.0°	17 per cent
Stove oil	34.0°	15 per cent
Fuel distillate and lubricants		44 per cent (not separated)
Asphalt	"D"	10 per cent
		100 per cent

No information is given regarding the quality of the light products. The heavy end seems to be rather unstable, even allowing for the decomposition always attending this method of distillation.

4483.†

Union Oil Company of California. Tar Flat Tunnel.

Gravity 24.3° Beaumé

This is a limpid oil of a deep greenish black color, clearly distinguishable from the jet black oils from the wells farther south. The odor is also flatter and less gassy.

Distillation.

Sample of 150 c.c. was distilled from copper, first three cuts dry, fourth cut in a stream of inert gas. Distillation was carried to a dry coke.

First cut	8.4 per cent	54.8° Beaumé
Second cut	8.0 per cent	38.3°
Third cut	10.2 per cent	33.3°
Fourth cut	70.4 per cent	25.4°
Fixed carbon	3.0 grams per 100 c.c. oil	
	100.0 per cent	

*Analysis by H. N. Cooper.
†Analysis by J. P. P.

Coke was calculated to asphalt by the usual factor, and fourth cut reduced in a stream of fixed gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	1.0 per cent	Approximate figures only.
Engine distillate	52.0°	7.0 per cent	
Kerosene	42.0°	6.0 per cent	
Stove oil	33.0°	12.0 per cent	
Fuel distillate	32.0°	22.5 per cent	Slop distillate 25.4°—66.5%
Reduced stock	19.3°	44.0 per cent	
Asphalt	"D"	7.5 per cent or 26 lbs. per bbl.	
		100.0 per cent	

The light products from this oil are of first quality, and refine readily. Lubricating stock is much more stable than is usual with these oils, and handles well. Reduced stock with usual treatment gives a 20.7° engine oil of a very fine color; the yield also is unusually large. On the whole, this is a better oil for refining than most of the oils of this region, though, like all tunnel oils, deficient in gasoline.

5462.*

Union Oil Company of California. Tar Flat, South Well.

Gravity ---------- 24.4° Beaumé

This is a limpid oil of brownish black color and rather sharp, gassy odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a stream of gas. Distillation carried to dry coke.

First cut	19.5 per cent	52.0° Beaumé
Second cut	11.4 per cent	41.1°
Third cut	31.8 per cent	33.1°
Fourth cut	34.7 per cent	19.6°
Fixed carbon	2.6 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor. Last cut reduced in a current of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	19.5 per cent	
Kerosene	42.0°	10.5 per cent	
Stove oil	33.0°	33.0 per cent	
Fuel distillate	30.0°	13.0 per cent	Slop distillate 19.6°—30.5%
Reduced stock	Solid	17.5 per cent	
Asphalt	"D"	6.5 per cent or 23 lbs. per bbl.	
		100.0 per cent	

The light products from this oil refine readily, to fair colors and sweet odor. The stove oil cut is badly burned, indicating much cracking of the lubricating stock. The latter is pasty with paraffin at 60° temperature, and the reduced stock sets solid at 70° F., making it useless for the manufacture of engine oil, as the paraffin from these oils does not crystallize.

*Analysis by P. W. P.

2425.*

Union Oil Company of California. Tar Flat, lease average.

Gravity ..... 25.4° Beaumé
Viscosity at 65° F. ..... 6.96° Engler (water, 1)
Flash point ..... 120° F., open test

This oil is very similar in appearance to the last sample, being a limpid oil, very dense and of a black color, with a gassy odor.

Distillation.

A small sample was distilled from a glass flask to a temperature of 518° F. The residue from this distillation was reduced by open evaporation to grade "D" (40 penetration), and the asphalt weighed. The figure for asphalt thus obtained is reduced by 20 per cent (one fifth) to correct for oxidation. Following are the direct figures:

Below 212° F.	Trace	
212 to 302°	10.0 per cent	56.0° Beaumé
302 to 518°	27.0 per cent	38.8°
Residue above 518°	63.0 per cent	16.8°
	100.0 per cent	
Asphalt	16.85 grams per 100 c.c.	

This is roughly equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	5 per cent
Engine distillate	52.0°	5 per cent
Kerosene	42.0°	18 per cent
Stove oil and lubricants	---	59 per cent (not separated)
Asphalt	"D"	13 per cent or 47 lbs. per bbl.
		100 per cent

4474.†

Union Oil Company of California. Tar Flat Nos. 31 and 32.

Gravity ..... 28.6° Beaumé

This is a very limpid oil, extremely black and opaque, with a gassy and rather sharp odor.

Distillation.

A sample of 150 c.c. was distilled in copper, first four cuts dry, last cut in a current of inert gas. Distillation carried to dryness.

First cut	8.8 per cent	58.1° Beaumé
Second cut	7.0 per cent	49.6°
Third cut	10.6 per cent	42.1°
Fourth cut	16.6 per cent	33.1°
Fifth cut	51.8 per cent	26.1°
Fixed carbon	5.2 grams per 100 c.c. oil	
	100.0 per cent	

The carbon is calculated to asphalt by the usual factor, and the last

*Analysis by E. N. Moor.
†Analysis by J. P. P.

cut reduced in a current of gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	6 per cent	
Engine distillate	52.0°	9 per cent	
Kerosene	42.0°	11 per cent	
Stove oil	33.0°	16 per cent	
Fuel distillate	34.0°	17 per cent	Slop distillate
Reduced stock	19.8°	28 per cent	26.1°—45%
Asphalt	"D"	13 per cent or 46 lbs. per bbl.	
		100 per cent	

The light products (down to and including kerosene) are rather dark, but treat out readily. The heavier oils break up badly. The reduced stock is dark in color and does not take the acid well, giving a very dark red oil, even at the high gravity of 22.8° for the finished oil.

This is a refining oil of fair quality only, and best at its light end.

5465.*

Slocum Oil Company. Well No. 5.

Gravity ..... 14.9° Beaumé

This is a moderately viscous oil of a brownish black color and a mild odor. It is rather less viscous and noticeably greener in tone than valley oils of the same gravity.

Distillation.

Sample of 150 c.c., distilled from copper, in a stream of fixed gas. Distillation carried to dry coke.

First cut	12.5 per cent	32.0° Beaumé
Second cut	78.7 per cent	20.9°
Fixed carbon	8.8 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor, and last cut reduced in gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	None	
Kerosene	42.0°	None	
Stove oil	33.0°	11.5 per cent	
Fuel distillate	30.0°	28.0 per cent	Slop distillate
Reduced stock	14.5°	38.5 per cent	20.9°—66.5%
Asphalt	"D"	22.0 per cent or 77 lbs. per bbl.	
		100.0	

The stove oil from this run is perfectly sweet, and free from any indications of cracking. The lubricating stock is dark in color, but of high viscosity, and gives a large yield of very viscous reduced stock. This treats with the usual acid to a red oil of 17.2° gravity, moderate viscosity, and good red color with strong green overtone.

*Analysis by P. W. P.

5463.*

Slocum Oil Company. Tunnel.

Gravity ---------- 22.5° Beaumé

This is a moderately limpid oil of an olive green color and bland odor.

Distillation.

A sample of 150 c.c., distilled from copper in a stream of gas, to a residue of dry coke.

First cut	26.5 per cent	33.1° Beaumé
Second cut	70.6 per cent	22.5°
Fixed carbon	2.9 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor. Lubricating stock reduced in a stream of gas, giving the following commercial analysis:

Gasoline	61° Beaumé	None	
Engine distillate	52°	None	
Kerosene	42°	None	
Stove oil	33°	26.5 per cent	
Fuel distillate	30°	25.8 per cent	Slop distillate
Reduced stock	16°	40.4 per cent	22.5°—66.2%
Asphalt	"D"	7.3 per cent or 16 lbs. per bbl.	
		100.0 per cent	

The first cut from this crude has a strong odor, and is in part a decomposition product. The lubricating stock, however, comes over clean, and gives a good yield of reduced stock of good color and fair viscosity. This treats with the usual dose of acid to a red oil of 19.9° gravity, moderate viscosity, and of a light red color with brownish tone.

It will be noted that the analysis of this oil, with a gravity of 22.5° Beaumé, is almost identical with that of No. 5 well on the same lease, the difference being in the percentage of stove oil and of asphalt. An explanation of this anomaly would be of great interest.

4433.†

Slocum Oil Company. West End Wells.

Gravity ---------- 24.3° Beaumé

This is a fairly limpid oil, of a greenish black color and mild odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, fourth cut in a stream of fixed gas. Distillation to a residue of dry coke.

First cut	8.0 per cent	49.1° Beaumé
Second cut	8.0 per cent	42.0°
Third cut	29.0 per cent	32.8°
Fourth cut	49.5 per cent	23.1°
Fixed carbon	5.5 grams per 100 c.c. oil	
	100.0 per cent	

*Analysis by P. W. P.
†Analysis by J. P. P.

Coke calculated to asphalt by the usual factor, and last cut reduced in a current of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	5 per cent	
Kerosene	42.0°	13 per cent	
Stove oil	34.0°	22 per cent	
Fuel distillate	30.0°	14 per cent	Slop distillate
Reduced stock	19.0°	32 per cent	23.1°—46%
Asphalt	"D"	14 per cent or 32 lbs. per bbl.	
		100 per cent	

The light products from this oil treated fairly well only—colors did not come up well, though treated oils were perfectly sweet. The heavy end of the oil breaks down considerably, and gives only fair products. Reduced stock with the usual dose of acid gave a 21.5° engine oil of a dull, brownish red color and low viscosity.

This oil, as is not unusual in this region, is overloaded with middlings, and does not show as good an analysis as the gravity would indicate.

4436.*

Slocum Oil Company. Lease average.

Gravity ——— 24.5° Beaumé

This is a limpid oil, having a black color with green tinge, and a somewhat gassy odor.

Distillation.

Sample of 150 c.c. was distilled from copper, first three cuts dry, last cut in a current of inert gas. Distillation carried to dry coke.

First cut	5.6 per cent	52.6° Beaumé
Second cut	12.0 per cent	42.8°
Third cut	30.3 per cent	33.2°
Fourth cut	45.7 per cent	23.9°
Fixed carbon	8.4 grams per 100 c.c.	
	100.0 per cent	

Coke is calculated to "D" asphalt by the usual factor, and fourth cut reduced in a stream of gas, thus getting the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	6 per cent	
Kerosene	42.0°	14 per cent	
Stove oil	33.0°	28 per cent	
Fuel distillate	32.0°	12 per cent	Slop distillate
Reduced stock	17.7°	19 per cent	23.9°—31%
Asphalt	"D"	21 per cent or 75 lbs. per bbl.	

The light products treated out perfectly sweet, though not to very good color. Lubricating stock was considerably cracked and gave only fair results. Reduced stock with 5 per cent acid gave a 19.5° engine oil of fair color and rather low viscosity. This oil is best at the light end, but is high in middle oils, and of moderate refining value only.

*Analysis by J. P. P.

2433.*

Slocum Oil Company. Well No. 1—Green.

Gravity ---------- 26.8° Beaumé
Viscosity at 68° F. ---------- 8.35 Engler (water, 1)

This is a moderately limpid oil, of a dull green color and bland odor.

Distillation.

A small sample distilled from glass to 518° F. Residue reduced to "D" asphalt (40 penetration) by open evaporation, and asphalt weighed. The yield of asphalt is corrected for oxidation. The original figures are:

Below 212° F.	3.1 per cent	
212 to 302°	10.4 per cent	54.0° Beaumé
302 to 518°	27.5 per cent	39.0°
Residue above 518°	59.0 per cent	15.9°
	100.0 per cent	

Asphalt ---------- 11.65 grams per 100 c.c.

This is roughly equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	5 per cent
Engine distillate	52.0°	8 per cent
Kerosene	42.0°	18 per cent
Stove oil and lubricants	---	60 per cent (not separated)
Asphalt	"D"	9 per cent or 32 lbs. per bbl.
		100 per cent

Silverthread or Sisar Wells.

This group of wells takes the name of Silverthread from the old placer mining district of that name, and Sisar (pronounced locally "see-saw") from the creek and cañon lying to the west and south. The name Astarte, applied properly only to the earlier wells on the Westlake Rommel lease, is that of a minor cañon crossing Lot 1 of section 18.

This group consists of wells of the Hilltop, Hillside Crude, Pyramid, and Capitol Crude Oil companies, and the Bard Oil & Asphalt Company, lying on the western end of Rancho Ojai, and the surveyed land immediately north. The rancho here consists of the narrow valley of Sisar Creek, and terminates where the latter enters Santa Paula Creek. South of Sisar Creek are a number of large brea beds, fed by live seepages of medium gravity black oil, but the small amount of drilling done on these seepages has so far been unproductive of results. One such seepage lies north of the creek, on the little flat between the creek bed and the north line of Rancho Ojai, and on this seepage a number of the shallow wells of the Bard Oil & Asphalt Company are located. The other wells of this group lie in a generally east and west line north of this tar bed, and on the south slope of the hills which form the north side of Sisar Cañon, these hills being the lowest portion of the main Topa Topa range. As the hills are steep and the producing formation dips to the north at a steep angle, the producing strip is but a narrow one, less than one half mile at its greatest extension, and at present is

*Analysis by E. N. Moor.

developed for a length of some one and one half miles, though not definitely limited at either end, as will be shown.

Old Wells—Union Oil Company "Sisar" and "No. 6" Leases—Sisar Oil & Asphalt Company. Between Bear Cañon and the west line of the Capitol Crude property a number of wells appear to have been drilled, the records of which are now very scattering and confused.

In the 1887 report of the State Mineralogist the following note is given: "About a mile farther up Sisar Creek (from the Sulphur Spring) is located a group of oil wells called collectively 'Ojai No. 6.' There are here now five or six old wells pumping an aggregate of some eight or nine barrels per day of a very dark, greenish-brown oil" * * * "These wells are in the midst of extensive asphaltum deposits and tar springs. Their depth varies from one hundred and twenty-five to something over five hundred feet. But there is one dry hole here about one thousand two hundred feet deep."

In the 1890 report, along with a number of new wells, the following are described: "Ojai No. 1 is located on the Ojai lease. It is drilled to a depth of 600 feet, and is dry. See-Saw (Sisar) No. 1 is located about 500 feet east of Ojai No. 1. It was drilled to a depth of 900 feet, and produces ten barrels daily. See-Saw No. 2 is located about 400 feet from No. 1. It has reached a depth of 400 feet, and is still being drilled." It is quite apparent that these wells are not the same as the ones above described.

In the 1896 report two separate groups of wells in the Ojai country are described as follows:

"Bard (Sisar) Wells. There are nine wells, 550 to 800 feet deep, about 6½ miles northwest of Santa Paula and immediately west of the wells belonging to the Capitol Crude Oil Company. The drillers state that nearly all these wells showed a crushed and disturbed formation, and that in one of them several feet of asphaltum was penetrated. Some idea of the average life of the wells in the Silverthread District may be gathered from the following table:

BARD WELLS, SILVERTHREAD OIL DISTRICT.

Wells.	Drilled.	Depth.	Yield when completed, barrels per day.	Yield in June, 1895, barrels per day.
No. 2	1892	350 feet	14	5
No. 3	1892	350 feet	5	3
No. 4	1894	450 feet	8	5
No. 5	1893	420 feet	20	6
No. 6	1893	420 feet	12	3½
No. 7	1893	350 feet	8	1½
No. 8	1893	750 feet	3	1½
No. 9	1893	750 feet	5	0
No. 10	1894	658 feet	3	1½

"Two varieties of oil are obtained from these wells—one of high specific gravity from the shallowest wells, and one of somewhat lower specific gravity from the deepest wells. Sisar Oil and Asphalt Company, of Hueneme, owner."

"Union Oil Company's (No. 6 lease) wells. They are in the Silverthread Oil District, about 6½ miles northwest of Santa Paula. They embrace nine wells, from 60 to 900 feet deep. In June, 1895, eight of them were being pumped; said to yield about 600 barrels of oil a month. Union Oil Company, owner."

Here are nineteen or more wells, drilled previous to 1895, of which but twelve can be located. The best information obtainable at present is that the wells now known as Pyramid were drilled by the Union in 1885 to 1887, and the first nine of these wells are probably identical with those described briefly in the 1896 report. The Sisar wells can not be located so readily. The wells now being operated by the Bard Oil & Asphalt Company are reported to have been drilled in 1896 and following years, but the 1894 report also mentions nine wells under the name "Sisi Oil Company," and the depths given for the Bard Oil & Asphalt wells do not at all agree with those stated in the 1896 report for the Sisar wells. It seems probable that the two old wells shown on the map, to the west of the Bard wells, are all that remain of these Sisar wells, and it is likely that there were also a number of old wells north of the grant line and west of the Westlake Rommel wells, of which the single well in "No. 6 Cañon" is the only remainder. A number of other wells appear also to have been drilled at various points over the brea beds along the east end of the ranch, but the notices are too vague to allow of their location.

Pyramid Oil Company. This company covers Lots 1 and 2 in section 18, and Lot 4 in section 17, or approximately 100 acres in all. The first developments were by the Union Oil Company of California, who drilled the first eight wells, in the years 1885 to 1898. In this latter year it was leased to the Westlake-Rommel Oil Company of Los Angeles, who drilled numbers 9 to 12, inclusive, and operated the property until 1909. In the latter part of this year, the lease passed to the Pyramid Oil Company of San Francisco, who drilled three wells, and who now operate the property.

The data as to the older wells is scanty, and even as to the newer ones is less definite than might be desired. It gives, however, some slight information as to the producing value and structure of this north-dipping formation.

Well No. 1 was drilled by the Union Oil Company, in 1885, to a depth of 960 feet, and was a producer. It is now on the jack, like all the later wells, up to and including No. 12, and is making about five barrels per day of medium gravity black oil.

Nothing is known as to No. 2, which was abandoned.

No. 3 was drilled in the same year to 860 feet, and is making about five barrels of oil of 26° gravity.

No. 4 is an abandoned hole, no information obtainable.

No. 5 and No. 6 were drilled in 1886, to depths of 456 and 450 feet, respectively. No. 5 is producing some six barrels of 22° oil, and No. 6 about three barrels of 19° oil.

No. 7 was drilled in 1887 to 960 feet, and is making about four barrels of 26° oil.

No. 8 was the last well of the Union Oil Company, and was drilled in the year 1888, to a depth of 840 feet. Amount and gravity of production are the same as for preceeding well.

Nos. 9, 10, and 11 were drilled by the Westlake-Rommel Oil Company in the same year. Nos. 9 and 10 were carried to approximately 975 feet; No. 11 is 1010 feet deep. They are producing four, four and five barrels, respectively, of oil running close to 23° gravity.

No. 12 was drilled by the same company, date not known. This well was carried to 1007 feet, but, finding no production below the top sand, was pulled back to 760 feet and plugged. It was last reported to be making some twelve barrels of 27° oil.

No. 13 was drilled in 1910, and at a depth of 1685 feet had penetrated at least a second sand. This well started off at some forty barrels per day of oil running close to 24° Beaumé, but rapidly fell off to about the same production as the older wells.

No. 14, otherwise known as Pyramid No. 1, was finished in the latter part of 1910 at a depth of 1765 feet, and started off at a rather heavy production, reported to be about 100 barrels a day. Like the foregoing, it rapidly dwindled, and during the current year was deepened to approximately 2800 feet, and is known to have passed through a number of shallow productive strata, but details are not obtainable. It appears doubtful, however, whether the results had at this depth warrant further exploitation of the lower lying sands.

No. 15, or Pyramid No. 2, was drilled in the current year, and it should be noted, in connection with the remarks anent No. 14, that this well was put on the pump at some 1700 feet, more or less.

Hilltop Oil Company. This company has a producer near the southeast corner of the southeast forty of section 7. This well was drilled in 1910 and is 2145 feet deep.

Hillside Crude Oil Company of Santa Paula has a well about one fourth mile east of the foregoing. This hole was drilled by the Northern Oil Company in 1902; was carried to 1460 feet, but gets its production at 930 feet. As this depth is quite insufficient to reach the sands found lower down the hill, we are forced to suppose that this well draws its supply from a higher sand, which does not apparently outcrop. There are no evidences of a second fault between this well and these to the south, and a further argument against this theory is the

steady production of this well, which started off at fifteen barrels per day, and is still making six barrels, after almost nine years' production. If this view be the true one, prospecting even farther to the north would be warranted, but to determine this point would require more data than is now available.

Capital Crude Oil Company. This company has twenty-two wells on the north half of section 17 and the northwest quarter of section 16, but very little information is to be had as to the depth and productiveness of these holes. Of the twenty-two, six are abandoned and pulled, the balance are producers. Of the abandoned holes but two depths are known, of No. 5 and No. 13, each said to be about 600 feet. The others abandoned are Nos. 4, 6, 10, and 11. Of the producers, Nos. 1 and 2 are said to be about 750 feet deep. Nos. 7 and 8 about the same. No. 12 is reported at 550 feet, and No. 15 at 530 feet. No. 20, drilled in 1902, is about 1000 feet deep. No. 21, drilled in 1909, is reported at 1400 feet, and No. 22, finished in 1910, at 2000 feet. The results on the last hole of this company, the farthest to the northeast in section 17, would indicate that the limits of production in this direction had not been reached, this well being reported as a very good producer of light oil. The production of this lease is given as 1500 barrels per month, of an average gravity of 22° Beaumé.

Bard Oil & Asphalt Company. This company have twenty-two wells on what is known as the Tower tract, a portion of the Rancho Ojai lying south of the Westlake-Rommel and Capital Crude wells. These wells are north of the creek, and range north and west from the brea bed just mentioned.

Well No. 1, drilled in 1896, is an abandoned well at 600 feet.

Well No. 2, drilled in the same year, produces four barrels per day at 780 feet.

Wells Nos. 3, 4, and 5 were drilled in 1897. No. 3 produces three barrels at 660 feet; No. 4 makes five barrels from a depth of 580 feet, and No. 5 three barrels at 800 feet.

Nos. 6 and 7 are abandoned holes, depths about 600 feet and 500 feet, respectively.

Well No. 8 is an abandoned hole. No. 9 is also abandoned, depth 450 feet. The depth of No. 10 is not known.

Well No. 11 is said to be good for four barrels at 780 feet. No. 11, drilled in 1899, is also a producer at 680 feet.

Well No. 13 is 820 feet deep, a producer.

Well No. 14 is a producer at 720 feet.

Well No. 15 is abandoned, depth not known.

Well No. 16 is 800 feet deep and a producer.

Well No. 17 is a producer at 960 feet.

Well No. 18 is a producer at 600 feet.

Well No. 19, producing at 810 feet, was drilled in 1903.

Well No. 20, a producer, is 610 feet deep.

The two wells farthest to the west are said to have been put down by the Sisar Oil & Asphalt Company, though possibly they were, like the westernmost well on the Westlake-Rommel, drilled by the Philadelphia-California Petroleum Company. At any rate, they are very old, of no great depth, and still produce a little oil, somewhat heavier than the average for this group.

The wells farthest to the southeast, and immediately in the tar bed, have not been successful, as will be noted from the map. Strangely enough, the small amounts of oil obtained in these wells has been of about the same gravity as that had from the deeper wells to the north. This is a very unusual condition, and rather hard to understand, as it is the almost invariable rule that oil produced from the immediate vicinity of a zone of crushing and faulting, such as will produce a seepage, is materially heavier than that found in the unbroken formation at even a slight distance.

It will be apparent from the foregoing that this territory is sharply limited to the south by the proximity of a deep fault paralleling Sisar Creek. South of this fault the later formations characteristic of Sulphur Mountain appear, and while there is no reason to deny that these later formations also may be productive, there is yet no direct evidence that they will be.

On the west the extremely small productiveness of the two old wells on the Ojai, and of the westernmost well of the Pyramid, would indicate a gradual diminution either in thickness or saturation of the sands in this direction, and, considering the output per well of the western wells of the main group, it is doubtful whether developments between these and the first mentioned would be profitable.

As to the north, if indeed the Hillside well found a higher lying and parallel sand, as has been suggested, there are possibilities that a considerable extension may be made to the north. If, on the other hand, this well found a "stray," and the producing formation must be found at the depth calculated from the dip along the north line of the grant, then it is highly probable that no further development down the dip will be profitable. At the best, this formation is none too regular, and, considering the steep pitch of the surface, the high angle of the sands and the presence of considerable water in the deeper wells, drilling is neither easy nor cheap, and it is doubtful whether wells of, say, ten barrels output at a depth of 1800 to 2000 feet can ever be very profitable. As to the east, there seem to be some probabilities of an extension in a northeasterly direction.

Quality of the Silverthread Oils.

The oils of the Silverthread group range in gravity from about 19° to almost 28° Beaumé, but the only sample available of the lowest gravity was accidentally destroyed. The analyses given below, however, cover a range from 21.6° to 27.3° Beaumé, and very fairly represent the bulk of the output of this group, the production of oil of the lowest gravity being very small.

All these oils are similar in appearance, being very limpid, of a brownish black color with a greenish tinge, very similar to that of the upper oils from the East Side, Coalinga. They all have the same odor, rather pungent and gassy, and very distinct from the flat odor of the green oils of the Ex-Mission.

The analyses given below, while they go no farther than the commercial fractions, betray considerable similarity in structure, and it is highly probable that these oils come from an identical source, and differ only in the relative percentage of light and heavy elements, this difference being ascribable to comparatively slight differences in the formations from which they are produced or through which they have traveled.

These oils are all of good refining quality, giving fair to high yields of light products, distilling freely, and giving usable heavy stocks, though these are not of the highest grade. The percentage of asphalt throughout is normal for the gravity.

It is a rather peculiar circumstance that no paraffin whatever appears in the lubricating stock from any of the oils of this group. This distinguishes them clearly from the oils of Bardsdale, which otherwise they resemble considerably.

5475.*

Capitol Crude Oil Company. Well No. 21.

Gravity ---------- 21.6° Beaumé

This is a limpid oil of brownish black color, with a gassy and penetrating odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a stream of inert gas. Distillation carried to dryness.

First cut ----------	9.8 per cent	51.5° Beaumé
Second cut ----------	13.7 per cent	40.2°
Third cut ----------	8.6 per cent	30.2°
Fourth cut ----------	62.8 per cent	19.5°
Fixed carbon ----------	5.1 grams per 100 c.c. oil	
	100.0 per cent	

*Analysis by J. P. P.

The carbon is calculated to the corresponding weight of "D" asphalt by the usual factor, and the last cut reduced in a stream of gas. The above figures are roughly equal to the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	10.0 per cent
Kerosene	42.0°	11.0 per cent
Stove oil	33.0°	11.0 per cent
Fuel distillate	28.5°	22.1 per cent } Slop distillate
Reduced stock	13.1°	33.1 per cent } 19.5°—55.2%
Asphalt	"D"	12.8 per cent or 45 lbs. per bbl.
		100.0 per cent

The light products from this oil refine well, giving finished oils of water-white color and mild, sweet odor. The lubricating stock holds up well in the crude distillation, and on steaming down gives a reduced stock of medium viscosity and good color, which treats out with the standard dose of acid (30 pounds per barrel) to a dark red engine oil. with a fair green outertone, of medium viscosity and 18.1° gravity.

This is a normal oil for its gravity, giving good products at both ends, with a yield of asphalt rather below the average, and only a small proportion of middlings.

4428.*

Capitol Crude Oil Company. Well No. 17.

Gravity ..... 22.7° Beaumé

This is a moderately limpid oil, of brownish black color, and gassy odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dryness.

First cut	11.3 per cent	50.9° Beaumé
Second cut	12.9 per cent	43.3°
Third cut	9.6 per cent	34.2°
Fourth cut	60.1 per cent	21.6°
Fixed carbon	6.1 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor, and lubricating stock reduced in a current of gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	10.0 per cent
Kerosene	42.0°	15.0 per cent
Stove oil	33.0°	9.0 per cent
Fuel distillate	32.8°	15.2 per cent } Slop distillate
Reduced stock	16.0°	35.5 per cent } 21.6°—50.7%
Asphalt	"D"	15.3 per cent or 53 lbs. per bbl.
		100.0 per cent

*Analysis by J. P. P.

The light products from this oil were not tested, but appeared to be of the usual quality. The lubricating stock was of good quality, and distilled freely. This is a normal oil for the gravity.

4430.*

Bard Oil and Asphalt Company. Well No. 12.

Gravity ---------- 24.0° Beaumé

This is a limpid oil, of a brownish black color, and penetrating, gassy odor.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dryness.

First cut	5.4 per cent	60.7 Beaumé
Second cut	5.4 per cent	53.4°
Third cut	15.0 per cent	41.8°
Fourth cut	8.6 per cent	32.8°
Fifth cut	59.8 per cent	21.8°
Fixed carbon	5.8 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor, and last cut reduced in a current of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	5.0 per cent	
Engine distillate	52.0°	7.0 per cent	
Kerosene	42.0°	15.0 per cent	
Stove oil	33.0°	8.0 per cent	
Fuel distillate	30.7°	16.8 per cent	Slop distillate
Reduced stock	14.8°	33.7 per cent	21.8°—50.5%
Asphalt	"D"	14.5 per cent or 51 lbs. per bbl.	
		100.0 per cent	

The light products from this oil were not tested, but were of normal appearance. The lubricating stock distilled freely and treated well. This is a normal oil for the gravity.

4432.†

Pyramid Oil Company. Westlake-Rommel No. 4.

Gravity ---------- 25.3° Beaumé

This is a limpid oil of a brownish black color and gassy odor.

Distillation.

Sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dryness.

First cut	10.3 per cent	60.9° Beaumé
Second cut	5.8 per cent	51.9°
Third cut	13.7 per cent	41.7°
Fourth cut	8.2 per cent	32.2°
Fifth cut	55.0 per cent	21.3°
Fixed carbon	7.0 grams per 100 c.c. oil	
	100.0 per cent	

*Analysis by J. P. P.

†Analysis by P. W. P.

Carbon calculated to asphalt by the usual factor. Lubricating stock reduced in a current of gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	10.3 per cent	
Engine distillate	52.0°	5.8 per cent	
Kerosene	42.0°	13.7 per cent	
Stove oil	33.0°	8.2 per cent	
Fuel distillate	32.9°	13.3 per cent	Slop distillate
Reduced stock	16.0°	31.2 per cent	31.3°—44.5%
Asphalt	"D"	17.5 per cent or 61.4 lbs. per bbl.	
		100.0 per cent	

The lighter oils from this crude do not come up to color in treatment as readily as usual, but are sweet. The heavy distillate runs readily and without much cracking, and the percentage of middlings is very low. The reduced stock is of good color and fair viscosity, and treats out with the usual dose of acid to a bright red engine oil, of fine green outertone, medium viscosity, and 18.9° gravity.

This is an unusually good oil for the gravity, giving high yields at the ends and low yields of middle oils. It will be noted that the asphalt is higher than the average for this gravity and location.

4429.*

Pyramid Oil Company. Pyramid No. 2.

Gravity ..... 25.5° Beaumé

This is a limpid oil of a brownish black color and gassy odor.

Distillation.

Sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a stream of inert gas. Distillation carried to dry coke.

First cut	8.8 per cent	61.5° Beaumé
Second cut	8.8 per cent	51.9°
Third cut	12.9 per cent	42.0°
Fourth cut	8.1 per cent	33.3°
Fifth cut	57.0 per cent	22.1°
Fixed carbon	4.4 grams per 100 c.c. oil	
	100.0 per cent	

Carbon calculated to asphalt by the usual factor. Heavy stock reduced in a current of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	9.5 per cent	
Engine distillate	52.0°	9.0 per cent	
Kerosene	42.0°	13.5 per cent	
Stove oil	33.0°	8.5 per cent	
Fuel distillate	30.7°	16.4 per cent	Slop distillate
Lubricating stock	14.8°	32.1 per cent	22.1°—48.5%
Asphalt	"D"	11.0 per cent or 39 lbs. per bbl.	
		100.0 per cent	

*Analysis by J. P. P.

The lighter products from this crude refine very readily, giving water-white and sweet products. The lubricating stock is only fairly stable, and is rather bluish and dark in color, as is also the reduced stock. The viscosity of the latter, however, is good, and it treats out with the test acid to a 16.4° red engine oil of a good viscosity, and a very handsome cherry red color with strong green overtone.

This crude shows only a fair analysis for an oil of this gravity, but is readily handled.

5476.*

Capitol Crude Oil Company. Well No. 8.

Gravity ..... 26.2° Beaumé

This is a limpid oil of brownish black color, and gassy, penetrating odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a current of inert gas. Distillation to dryness.

First cut	10.2 per cent	59.3° Beaumé
Second cut	13.5 per cent	49.0°
Third cut	13.1 per cent	35.8°
Fourth cut	52.9 per cent	18.7°
Fixed carbon	9.9 grams per 100 c.c. oil	
	99.6 per cent	

Carbon calculated to asphalt by the usual factor. Last cut reduced in a current of gas. These figures are very roughly equal to the following commercial analysis:

Gasoline	61.0° Beaumé	7.0 per cent	
Engine distillate	52.0°	13.0 per cent	
Kerosene	42.0°	9.0 per cent	
Stove oil	33.0°	8.0 per cent	
Fuel distillate	29.0°	14.0 per cent	Slop distillate
Lubricating stock	13.3°	24.0 per cent	18.7°—38.0%
Asphalt	"D"	24.8 per cent or 87 lbs. per bbl.	
		99.8 per cent	

The light products from this oil treat very readily to water-white, sweet oils. The percentage of middlings is very low, and of asphalt very high for an oil of this gravity.

The lubricating distillate cracks somewhat, but comes over with a good color and medium viscosity. The reduced stock is of a dull color, low gravity, and high viscosity. The engine oil from this stock is a rather dark red color, with a fine green outertone, has a high viscosity with a low cold test, and shows the gravity 16.4° Beaumé.

The light end of this oil is rather smaller than is usual with oils of this gravity, and the heavy end of the crude is the best. On the whole, it is a very fair refining oil.

*Analysis by P. W. P.

7415.*

Capitol Crude Oil Company. Well No. 20.

Gravity ---------- 27.3° Beaumé
Viscosity at 60° F. ---------- 2.23 Redwood (water, 1)
Viscosity at 180° F. ---------- 1.24 Redwood (water, 1)
Flash point ---------- Below 60° F., Abel-Pensky test

Distillation.

Sample of 200 c.c., distilled from glass without steam or gas.

Below 212° F.	9.0 per cent	63.9° Beaumé
212 to 302°	16.5 per cent	51.3°
302 to 392°	11.8 per cent	0.8°
392 to 482°	7.7 per cent	32.6°
482 to 572°	9.1 per cent	27.3°
572° to grade	31.8 per cent	26.9°
Asphalt	13.0 per cent	Grade "D" (about)
Loss	0.1 per cent	
	100.0 per cent	

This is roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	11 per cent
Engine distillate	52°	13 per cent
Kerosene	42°	13 per cent
Stove oil	33°	8 per cent
Fuel distillate and lubricants	27°	42 per cent (not separated)
Asphalt	---	13 per cent
		100 per cent

O'Hara or Paula Wells.

Lewis & Jones Oil Company—Golden West Oil Company—Paula Oil Company. The small and isolated group of wells on the northwest quarter section 22, 4–21 consists of four producers and one abandoned hole drilled many years ago, and one producer and one abandoned hole of late date. In 1892 and 1893 two deep and three shallower holes were drilled by Lewis & Jones, or the Jones Oil Company of Los Angeles. Later the lease passed to the Golden West Oil Company, who apparently did no drilling. Still later, and for a number of years, the property was operated by Mr. Ed O'Hara of Santa Paula, and in 1910 passed to the Paula Oil Company, who drilled a crooked hole and a deep producer.

Well No. 1 of the Lewis & Jones Company was drilled in the latter part of 1892, and is said to have yielded originally 900 barrels per month, but in June, 1895, was credited with 300 barrels per month. At present this well is pumped about four hours per day, and yields but a very small quantity of oil. This well was carried to a depth of 1170 feet, and found oil at 575 feet, 705 feet, 805 feet, 965 feet, 1100 feet, and 1155 feet. A full log of this well is given on page 37 of Bulletin 11, California State Mining Bureau.

*Analysis by H. N. Cooper.

Well No. 2 was carried to a depth of 1125 feet, and stopped in running sand. This well found oil at 190 feet, and 854 feet, but drew its principal supply from the upper sand. Though this well was but 700 feet southwesterly from No. 1, there is a notable lack of correspondence in the logs. In June, 1895, it was said to be yielding about one barrel per day of rather heavy oil, from the sand found between 190 feet and 215 feet. This well is still being pumped.

The depths of Nos. 3, 4, and 5 can not be learned, but the shallowest of the three is said to be 430 feet deep. Nos. 3 and 4 are still on the jack, but were not being pumped when last visited. No. 5 had already been abandoned in 1903.

Well No. 5B was drilled by the Paula Oil Company in 1910. This well is located south of the ridge road, on the flat just north of the creek bed. This is reported as a crooked hole at 600 feet, and is abandoned.

Well No. 6 was started in the same year. It was carried to a depth of 2200 feet, but gets all its oil from a depth approximating 800 feet, the hole being entirely barren below. This well is being pumped.

In 1895 the production of this lease, with five wells, is given at 3000 barrels per month. In 1900 the production is said to have been 400 barrels per month. At present the production is not exactly known, but is apparently about what it was in 1900. The gravity of the oil is about 19° Beaumé—a full analysis is given in a later chapter.

The formation on the surface at the location of these wells dips sharply to the north, and the records of drilling seem to bear out the conclusion that the wells were drilled very nearly on the outcrop of the sands. The well of the Pure Oil Company, immediately to the north, went 1900 feet to get the same sand, and found it more productive and carrying a much lighter oil. The results from Well No. 6 seem to bar any likelihood of finding an underlying sand, and it is apparent that any further prospecting must be done to the east and west, along the strike, or to the north, down the dip of the formation.

Scattering Wells.

Immediately west of the location of the Paula wells, the Union Oil Company in 1886 drilled two holes on the Herman Ahnlauf tract in section 21. The first was a spoiled hole at 300 feet, the second reached warm flowing water at 1700 feet. This water carried small quantities of very heavy oil, so heavy as to sink to the bottom of the tank into which water was allowed to flow. This well is still making water and some gas, and is carrying a little oil, perhaps one barrel a day, which seems to be somewhat lighter than the oil originally produced.

Fleischer Oil Company. Near the center of section 9, and in a branch of Santa Paula Cañon, the Fleischer Oil Company were drilling in 1910. No reports as to the results from this well have been received. This test is interesting, being far to the north of any other development in this township.

Ventura Oil Company. The most northerly well in this township is a hole on the old Vulture claim, in the extreme southeast corner of section 4. This well is said to have been drilled in 1895 with a spring pole, to a depth of 80 feet, and to now have 60 feet of oil standing in the casing.

Another hole credited to this company, or one of similar name, is located at the junction of a northerly trending cañon with Santa Paula Creek, just north of the south line of section 9. No information as to this hole can be had.

Chicago Petroleum Company. In the southeast corner of the same section, and on the hillside southeast of Santa Paula Cañon, the Chicago Petroleum Company drilled a 952-foot dry hole in 1902.

Ferndale Oil and Petroleum Company. This company drilled a shallow hole in the year 1902, on the Dietz property (Ferndale Ranch), near the center of section 16. The depth of this hole is uncertain, but is reported at 590 feet—no results.

Woods well. The well at the extreme southeast corner of the Rancho Ojai, on the east bank of Santa Paula Creek, is known locally as the Woods well, and is stated to have been drilled in 1904, to a depth of 1400 feet. This well is said to have been abandoned as non-productive, though it is now flowing a little heavy oil. It may possibly have been drilled by the Hartford Oil Company.

Near the southeast corner of section 16, F. H. Allen drilled two wells at about the same time. Nothing can be learned as to the results from these wells, which have been abandoned—they appear to have been dry.

Paxton Gold Bond Oil Company. This company drilled on the northwest quarter of section 15, in 1902. The hole was carried to 1100 feet, without any traces of oil.

Chicago Ferndale Oil Company. In the same year, this company drilled on the opposite bank of the same cañon, near the center of the west line of section 15. This hole was dry at 1700 feet.

Acquila Oil and Mineral Company. This company drilled to a depth of 300 feet, on the southeast quarter of the southeast quarter of section 15. This rig was lost by fire, and never replaced.

Hartford Oil Company. Close to the Acquila location, the Hartford Oil Company drilled in 1901, abandoning at 1250 feet because of crooked hole. No oil found.

Pure Oil Company. This company drilled in 1901, on the south line of section 15, and just north of the Paula wells. The depth of the hole is reported as 1906 feet, and the initial production as thirty barrels of oil, approximating 30° gravity. This well was on the pump in 1903, but the rig was destroyed some time since and has not been replaced.

Mupu Oil Company. This company drilled in 1910, at the foot of the hills east of Santa Paula Creek, in the northwest quarter of section 27. It is reported that this hole reached a depth of 1400 feet, and obtained traces of oil. Well was rigged, but not operating when last visited.

California Crude Oil Company. This company has a hole reported to be 580 feet deep, drilled at about the same time, just southwest of the above.

Cooper Oil Company. A well was drilled in 1909 on the lands of Florence Cooper, or the Cooper Oil Company, on the southeast forty of section 34. Well said to have been drilled by Cheseborough & Goldner, depth 950 feet—no results.

Davis & Remington. In the southwest quarter of the northwest quarter of section 20 is a well said to have been drilled before 1884 by Davis & Remington. This hole is reported to have been dry at 1600 feet.

Empire or Loma Wells.

Along the line between sections 13 and 24, and extending into the southeast corner of section 14, and the southwest corner of section 18, 4–20, the Empire Oil Company of Los Angeles have five producing wells, fourteen abandoned and one drilling. No information as to these wells could be had, but they are believed to range from 1000 to 1500 feet in depth. The central group were drilled in the eighties by the Loma Oil Company and were steady small producers for many years. Timber Cañon No. 3, in section 18, 4–20, was drilled in 1901 to a depth of 1100 feet, and has since been a producer. The West End wells were drilled later. The oil from this lease is very light, much of it running above 35° gravity, as shown by analyses below. There is nothing to indicate that the limits of this producing strip have been reached at either end (east or west).

Santa Clara Oil and Development Company. This company is drilling on the north half of the southwest quarter of section 13, about one quarter mile north of the nearest Empire well.

Santa Paula Gravity Oil Company. In the northwest corner of section 20, 4–20, on a steep hillside east of Timber Cañon, a well was drilled

in 1902 by the Santa Paula Gravity Oil Company of San Francisco. This well was abandoned at 800 feet, without any known results.

Ventura Oil Company. South and a little east of the foregoing is a well said to have been drilled in 1899 by the Ventura Oil Company, or Ventura Oil and Land Company. Reported to have had traces of light oil at about 900 feet, and to have been abandoned because of mechanical troubles.

QUALITY OF O'HARA OR PAULA OILS.

A full analysis of the average oil now being produced by this lease will be found in Chapter 22. The following analyses, made in the year 1895, though incomplete, will be interesting as showing the character of the oil when the wells were younger. The heavier grade of oil, described in No. 7490, is not now being pumped, and was probably drawn from one of the shallow wells now abandoned.

7489.*

Lewis & Jones Oil Company (now Paula Oil Company).

Gravity ..... 18.4° Beaumé (0.9435 sp. gr.)

This sample was collected and analyzed in the year 1895, when the wells had been producing about two years. The number of the well from which sample was taken is not stated.

Distillation.

This sample was distilled dry, from a glass flask or retort, but no details as to methods are given.

Below 150° C.	Traces	
150 to 200°	5.6 per cent	49.9° Beaumé
200 to 250°	6.4 per cent	44.3°
250 to 300°	14.4 per cent	34.1°
300 to 350°	6.0 per cent	30.3°
Residue	67.6 per cent	Not recorded
	100.0 per cent	

This is roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	2.6 per cent
Kerosene	42°	9.4 per cent
Stove oil	33°	20.4 per cent
Residue	---	67.6 per cent
		100.0 per cent

7490.*

Lewis & Jones Oil Company (now Paula Oil Company).

Gravity ..... 13.3° Beaumé (0.9769 sp. gr.)

This sample was collected and analyzed in the year 1895, when the wells had been producing about two years. The number of the well from which the sample was taken is not stated.

*Analysis by W. L. Watts.

Distillation.

This sample was distilled dry, from a glass flask or retort, but no details as to methods are given.

Below 150° C.	Traces	
150 to 200°	Traces	
200 to 250°	Traces	
250 to 300°	13.0 per cent	34.1° Beaumé
300 to 350°	3.0 per cent	Not recorded
Residue	84.0 per cent	Not recorded
	100.0 per cent	

As the great bulk of this oil lies in the residue, which was not fractionated, the deductions to be drawn from these figures hardly go farther than to show that no light products were present.

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	16.0 per cent
Residue	--	84.0 per cent
		100.0 per cent

Looking North in Little Sespe.

Looking North on Little Sespe Ridge. The Consistent Dip to East is Clearly Indicated.

CHAPTER V.

SESPE AND HOPPER CAÑON WELLS.

Township 5-20.

The south line of this township and of that to the west coincide closely with a high ridge, north of which lies the cañon of Sespe Creek. This cañon, the southern wall of which is everywhere very steep, is an alternation of narrow cañons and small valleys, the latter well watered, fertile, and of great beauty. Near the west line of this township Sespe Creek enters a narrow gorge, which prevents communication from the lower end, and renders the valleys farther up the creek accessible only from the west, from Matilija, or over the ridge east of this point, from Nordhoff. On section 22 the gorge widens to an irregular valley, and in this valley, in section 26, Sespe Creek receives the waters of Tar Creek, and, bending abruptly to the south, enters another gorge, known locally as Big Sespe Cañon, and terminating south of the township line in the flat but narrow valley debouching at the town of Fillmore. The lower Sespe Valley, comprising parts of sections 22, 23, 24, and 26, is thus accessible from the south, by means of a rather rough road through the lower gorge, while Rose Valley and other valleys farther to the west are, as said, open to communication only at the west end.

Sespe Creek is fed entirely by streams from the north, the south side of the cañon being a very steep ridge, draining almost entirely to the south side, and therefore away from the creek. The north side of the cañon, however, slopes more gently away to the high mountains, and consists of rough, wooded hills, watered by clear streams, and by many hot and cold springs.

Geology.

Sespe Cañon appears to follow a main east and west fault line, terminating, or rather cross-faulted, along the east line of sections 2 and 35. North of the east and west fault, the formations exposed are brown sandstone and shale of the Middle Sespe period, and dip with some regularity to the north. East of the cross fault, the rocks exposed are red and gray sandstones of Lower Sespe age, dipping mainly to the east. South of the main fault, the characteristic rocks are quartzites and shale, mainly of Topa Topa age, and dip generally to the south. Much of the sandstone brought to the surface by these movements is a hard brownstone of great durability, valuable as a building material, and worked for that purpose in Big Sespe Cañon. This brownstone, by its resistance to erosion, has strongly characterized the surface of this country, and from this material is carved the very striking and beautiful gorges both above and below section 23.

The presence of petroleum in Sespe Cañon was betrayed by seepages of very heavy oil, naturally occurring along the fault lines. The wells drilled close to these lines have, as a rule, produced some oil, though in some cases only in small quantity. Three or four wells drilled further back, and apparently on unbroken formation, have not been successful, but the detail geology of this country is too little known to warrant an opinion as to the accessibility of the oil measures from which these seepages are fed. It is probable, however, that the prospects do not lie east of the north and south fault.

Union Oil Company of California—"Thirty-Six" Claim. This company drilled the first well in Big Sespe, on a flat lying east of and considerably above the creek. This well was drilled in 1898, reached a depth of 2190 feet, and, as it obtained only a trace of tar, was abandoned when completed. As this well lies to the east of the cross fault, and apparently out of the reach of any seepage, the occurrence of even a small amount of tar is of interest, if true, and a prospect hole so located would, at the present time, undoubtedly be carried to a greater depth. It may be pointed out, however, that such a report, after the lapse of thirteen years, is none too certain.

Crawford, Henley & Company. A partnership under this name drilled two holes on the Tar Hole claim, in the southeast quarter of section 35, in 1899 and 1900. No. 1 was on the east bank of the creek, and was carried to a depth of 562 feet. The oil from this well, about four barrels per day, was very heavy, about 11° Beaumé, and was found at 120 feet, the hole being barren below this depth. No. 2 was on the west bank of the creek, and obtained about two barrels of similar oil. This well was drilled in 1900, to a depth of 760 feet. Neither of these wells has been operated continuously at any time.

Sespe Crude Oil Company. This company, a Los Angeles corporation, drilled in 1901 on the Joe Gilbert claim, in the northeast quarter, about one half mile above the Crawford-Henley wells, and on the east side of the creek. This well was 1120 feet deep, obtained traces of heavy oil at 320 feet, but nothing below, and was abandoned.

Sespe Cañon Oil Company. A well was drilled by this company in 1902, just north of the south line of section 23, on land of the Union Consolidated Oil Company. This well was drilled to 1800 feet, and was reported at the time to have thirty feet of producing sand, but was never pumped, so far as can be learned.

Big Sespe Oil Company of Arizona—Union Consolidated Oil Company. These wells are on the southwest quarter of section 23 and the northeast quarter of section 26, and appear to be located in more or less disturbed ground at the focus of the two faults.

Well No. 1 was drilled in 1901 by the Union Consolidated Oil Company and is 580 feet deep. An initial production of sixty barrels per day is reported, but this is now much diminished, though the well is still producing.

Well No. 2 was drilled in the same year, and to about the same depth. It produced twenty barrels daily for a time, but was being deepened when last visited.

Well No. 3 was drilled in the same year, to a depth of 700 feet, had an initial production of about twenty-five barrels, and is still producing. All these wells are on the southwest quarter of section 23, and produce an oil of about 14° gravity.

No. 4 was drilled in the same year, and was the last well of the Union Consolidated Oil Company. It is at the junction of Sespe and Tar creeks, and is a producer of 14° oil at about 1000 feet.

No. 5, just west of 1 and 4, and No. 6, just north of 2, were in process of drilling in January, 1911. This work was being done by the Big Sespe Oil Company of Arizona (Los Angeles), successors to the Union Consolidated Oil Company. This company should not be confused with the Big Sespe Oil Company (of California), who, until lately, operated the Razzle-Dazzle wells, on section 1, 4–20.

Pine Mountain well. A well is reported to have been drilled on Pine Mountain, on section 33, 7 north, 21 west, by T. J. Hook and others of Los Angeles. This well was drilled in 1902, or thereabouts, to a depth exceeding 2000 feet, but no results were reported.

Township 4-20.

This township contains no defined producing group, but rather the overlap from two other townships.

Four wells in sections 18 and 20, belonging properly to the Empire or Loma group, are described under township 4–21.

The Kentuck, Star Oil, and Razzle-Dazzle Wells are included in the Little Sespe-Tar Creek group, in townships 5–19 and 4–19.

A few scattering prospect holes are noted below.

Searchlight Oil Company. On the Gird claim, northwest quarter of section 2, on the west bank of Sespe Creek. This well was drilled in 1901, and abandoned because of water trouble. No oil—depth 650 feet.

Flagstaff Oil Company of Flagstaff, Arizona. A well on the H. F. McIntyre place, in the northwest quarter of section 12, west of Sespe Creek, and on the south slope of the ridge dividing this valley from Pine Creek Cañon. Drilled in 1901, depth 1400 feet, traces of oil reported, abandoned.

Arizona Oil Company. A well on the G. E. Webb tract, near the east line of section 13. No data; abandoned.

Crude Oil Company. On the M. Fine tract, northeast quarter of section 24. A well drilled in 1900, reported 580 feet; no oil; abandoned.

Townships 5-19 and 4-19.

The geology of the strip of territory covered by these two townships is, in its broader aspects, plainly indicated by the topography. The north and south fault, which locates the lower gorge of Big Sespe, continues to the south with but a single swing to eastward, which brings it near to the east line of 4–20. Where this fault occurs in hard sandstones it causes a narrow gorge, but farther to the south, from near the center of section 12, 4–20 to the town of Fillmore, erosion of the soft shales of the lower hills has produced a flat, fan-shaped valley, almost exactly coincident in bounds with the old land grant known as Sespe No. 2.

It will be noted from the maps that from the north and south center line of 5–19 to Big Sespe Cañon, all the creeks have a generally westerly direction, while east of this line they flow to the east. As a matter of fact, the crest of the ridge almost exactly follows this center line, dropping toward the south line of 5–19, where it disappears, merging in the general south slope of the hills in the northwestern sections of 4–19.

With some minor variations, it is safe to assume that the westerly half of township 5–19, the nine sections comprised in the northwest quarter of 4–19, and the six sections along the east line of 5–20, exhibit the eroded edges of formations dipping almost due east, so that in passing from west to east anywhere within these limits we pass over the edge of the strata, from lower to higher, while east of these bounds we follow down the dip. The eastern limit of this east-dipping fault block appears to coincide loosely with Hopper Cañon, where another long north and south fault occurs.

It should not be forgotten that this general dip to the east is locally very much disturbed by folding and crumpling in the opposite direction, so that the dips on the surface, instead of being toward the east, are actually to the northeast and southeast. But it will be found a great aid to an understanding of this complex and difficult country to bear in mind the conception of a single great block, extending from Sespe Cañon to Hopper Cañon, raised at its west side, with its maximum elevation along the north and south center line of range 19, and with its strata all dipping primarily to the eastward, but locally contorted by folds and minor faults with east and west axes. While the location of petroleum deposits at particular points has undoubtedly been governed mainly by the location and shape of these minor folds, yet the elevation to an accessible distance of the oil measures has been due to the tipping up of this block at its western edge, and there is little doubt that unless there are between Sespe and Hopper other main north and south faults

not yet noted, when once the limit of depth of the formations cropping along Little Sespe is passed there must be a strip of barren territory extending nearly or quite to the Hopper Cañon fault.

The dip to the east is, as said, varied somewhat by local disturbances, but, taking this block as a whole, approximates ten degrees. The level of Sespe Cañon on section 26 is about 1000 feet, while the crest of the ridge on sections 9 and 16, 5–19 has an elevation of about 4000 feet. As the surface thus dips sharply to the west, and the stratification as abruptly to the east, we have a long succession of outcrops, some showing seepages; and further, in drilling for any given stratum, as we go east the depth increases by the surface slope plus the dip, which makes the producing belt of Tar Creek and Little Sespe a narrow one.

Most of the original wells were located at or near seepages, which helps to explain a large number of failures, such wells being, in the main, located west of and below the sand giving the seepage, and not sufficiently deep to reach a possible lower sand. It must be admitted, however, that, owing to folding along east and west axes, even such wells as did penetrate the productive sands have been rather uncertain in their output, both the thickness of the oil sands and their degree of saturation varying considerably from well to well, even directly along the line of strike.

Most of the new work is being done to the east of the old wells, with the design of reaching known sands at a greater depth, and is meeting with some success. Some work is also being done to the north, along the line of outcrop or slightly to the east, but has not yet resulted in discoveries.

This country is highly inaccessible except along the one road following the line of developments, and located well up on the ridge. As these hills are rocky and extremely rough, this road is a very bad one, narrow, and having some trying grades, and haulage to the more northern leases is a very serious item of cost. Certain advantages, however, which will be mentioned farther on, have made this country attractive to the prospector in spite of its difficulties, and it is at present the scene of considerable activity.

DEVELOPMENTS IN LITTLE SESPE-TAR CREEK GROUP.

The strip following the main seepages, and for some distance west, was originally located, and in part proven and patented, by the Union Oil Company of California, and the work done by this company so preponderates in quantity that we must here depart from the usual custom of working from northwest to southeast, and first describe the work done by this company.

A very peculiar feature is encountered here, in that we are dealing with territory containing a large number of wells, many once producers, but all (excepting at the extreme south) now abandoned, from which fact the natural inference would be that the producing capabilities of the country had been exhausted. Such, however, does not appear to be the case when the records are examined. Some of these wells, indeed, were dry when drilled, and some were exhausted after a time, but many were certainly capable of commercial production at the time they were shut down, and there is hardly a doubt that these sands, and indeed many of these old holes, are now capable of profitable operation. An explanation of this very unusual circumstance is probably found in the discovery, at the time of abandonment, of new and more prolific fields elsewhere, coupled with the fact that these lands are held in fee, and could be safely allowed to stand idle.

The records for this group seem to be very incomplete, and are largely withheld from inspection. The details given below have been collected with great care, from original sources, and, while very scattering, are believed to be accurate so far as they go. Wells of the Union Oil Company of California are first given, divided according to mining claims on which they are located, those of other operators follow, under company headings. Unless otherwise stated, therefore, the well mentioned was drilled and is owned by the Union Oil Company.

Union Oil Company's Wells.

Arcadia Claim. One well, Tar Creek No. 19, abandoned when drilled. This well is immediately below (west of) a live seepage.

Twilight Claim. Two wells, Tar Creek Nos. 16 and 20. No. 16 was drilled in 1889 and was pumped for a time. It was abandoned with the other wells in about 1900 (this statement also applies to all wells noted below, unless otherwise expressly stated). In the latter part of 1910 this well was cleaned and put on the pump, and when seen was doing some thirty barrels per day, which was probably much above its average capacity. No. 30 was reported to be also cleaning in the early months of the current year (1910).

Irelan Claim. One well, Tar Creek No. 18.

Higgins Claim. Three wells, Tar Creek Nos. 13, 15, and 17. No. 13 was 810 feet (or more) deep, and was abandoned when drilled. No. 15 was a dry hole at 975 feet.

Carpenter Claim. Two wells, Tar Creek Nos. 11 and 14. No. 11 was 575 feet deep, and was probably a producer. No. 14 was a dry hole at 1690 feet.

Black Jack Claim. Six wells, Tar Creek Nos. 4, 8, 12, 24, 31, and one not located. No. 4 was 520 feet deep and probably a producer. No. 8

was probably a producer at 570 feet, and No. 12 the same at 571 feet. No. 24 was drilled in 1890, was 880 feet deep, and had an initial production of 33 barrels per day.

Cesapi Claim. This was the heart of the old producing district, and had sixteen wells, Tar Creek Nos. 1, 2, 5, 6, 7, 9, 10, 21, 22, 23, 25, 27, 28, 32, and 33.

No. 1 was the first well in the entire territory, was drilled in 1887, and was a producer at 960 feet.

No. 2 produced six barrels per day for a time, at 645 feet.

No. 5 was a dry hole at 710 feet.

No. 6 was a dry hole at 875 feet.

No. 7 is recorded as "a good well, soon exhausted" at 435 feet.

No. 10 was probably a producer, at 660 feet.

No. 21 was a producer, depth not known.

No. 23 was 880 feet deep, but pulled back and plugged at 673 feet, and was still on the pump in 1898.

No. 25 was drilled in 1891, was 950 feet deep, and produced four barrels per day.

No. 27 was good for thirty-five barrels per day, at 710 feet.

No. 28 was drilled to 1630 feet, but had no oil below 735 feet, and was pulled back and plugged at 800 feet. The initial production was thirteen barrels per day.

No. 33 was drilled in 1898, and was a producer at 995 feet.

Connection Claim. One well, Tar Creek No. 3, a dry hole at 775 feet.

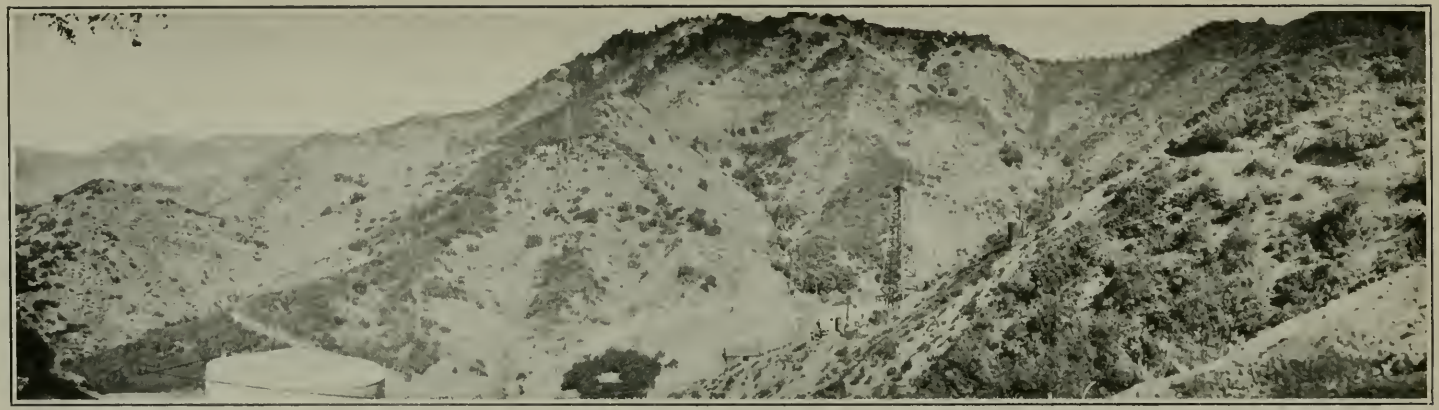
The above figures and data are from notes made at about the time the wells were abandoned, and undoubtedly refer to the depths at which wells were finally operated. From another source considerable information referring to the time at which these wells were drilled is available, and as the figures do not in all cases agree, they are tabulated below for comparison. Fortunately, the locations given in the older notes check out in every case with those shown on the map, which is reduced from an original lease map made about 1898. (See township 4–21 map of Ventura County.)

No.	Claim.	Depth 1.	Depth 2.	Initial output.	Remarks.
1	Cesapi	196	960	40	Very dark greenish-brown oil.
2	Cesapi	206	645	150	Fell to 75 in 3 months, later to 6 barrels.
3	Connection	700	775	00	Dry hole, into red rock.
4	Black Jack	400	520	75	
5	Cesapi	700	710	00	Dry hole, into red rock.
6	Cesapi	900	875	00	Dry hole.
7	Cesapi	375	435	75	20 barrels at 300 feet, fell away fast.
8	Black Jack	370	570	75	Down to 45 barrels in six months.
9	Cesapi	340	1240	75	
10	Cesapi	350	660	75	Heavier oil.
11	Carpenter	400	575	30	Rapidly dropped to 8 barrels.
12	Black Jack	650	571	10	
13	Higgins	600	810	10	
14	Carpenter	1400	1690	00	Traces at 500, dry below.
15	Higgins	---	975	00	Much water, a little oil.
16	Twilight	850	---	30	Flowed 800 daily short time.
17	Higgins	420	---	30	
18	Irelan	600	---	60	
19	Arcadia	900	---	00	Dry hole.
20	Twilight	665	---	30	
21	Cesapi	710	---	30	
22	Cesapi	390	---	30	
23	Cesapi	645	880	250	Pulled back and plugged at 673 feet.
24	Black Jack	850	880	200	33 barrels daily steady production.
25	Cesapi	825	950	10	4 barrels daily steady production.
26	—— ——	---	---	00	Crooked hole, not located.
27	Cesapi	745	710	200	35 barrels steady production.
28	Cesapi	---	1630	---	Oil at 735, plugged 800, 13 barrels steady.
29	Cesapi	---	---	---	
30	Black Jack	---	---	---	
31	Black Jack	---	---	---	
32	Cesapi	---	---	---	
33	Cesapi	---	995	---	A producer.
34	—— ——	---	---	---	Drilling in 1899, not located.
35	—— ——	---	---	---	Drilling in 1899, not located.

Depth 1 is the figure given by notes of 1887 to 1889. Depth 2 is figure given by notes of 1898 to 1900. Initial production is in barrels daily.

The first recorded production from the upper Sespe region is for the early months of 1887. In June of this year a total output of 5514 barrels is reported, this being from Well No. 1 for about 120 days, and for Well No. 2 for about 60 days, a total of 180 days, or about 31 barrels per day per well.

In 1892 the group is said to have yielded at the rate of 1500 barrels per month. This covers the output of 32 wells, of which 25 had originally been productive, and would be an average of but 2 barrels per day if all 25 were still being pumped, which is doubtful. In 1895 it is reported that but five wells were on the pump, and these making some 900 barrels per month, or an average of 6 barrels per day each. It will be noted that in 1892 the average age of these wells was but four or five years, and an extremely rapid decline from initial production is indicated.



Sespe, Looking Northeast on Four Forks Claim. The Cap Rock Shows Clearly on Left Skyline. This Hard White Cap May be Followed North a Long Distance, Always Dipping East.

Upper Sespe, Ventura County.

Maple Creek Claim. Two wells, Maple Creek Nos. 1 and 2. No. 1 was drilled in 1898, and reported to have started off at three hundred barrels, at 1275 (or 1400) feet. It had been abandoned in May, 1899, and must have been a pocket hole. No. 2 was a dry hole, depth not known.

Wildcat Claim. One well, Wildcat No. 1. A producer, probably drilled in 1897, and on the pump up to 1898, or later. This claim is now under lease to the Cosmopolitan Oil Company.

Hogsback Claim. One well, Hogsback No. 1, drilled in 1896, a dry hole at 1110 feet.

Hogshead Claim. Six wells, Hogshead Nos. 1, 1A, 2, 3, 4, and 5. No. 1 was drilled in 1896, and was a dry hole at 1370 feet. The five succeeding wells were all on the pump in 1898; no other data.

Kenyon Claim. One well, Kenyon No. 1, originally a producer and on the pump in 1899, but now dead.

Alamo Claim. One well, Alamo No. 1, probably a dry hole.

Sidehill Claim. Two wells, Sidehill Nos. 1 and 2. No. 1, drilled in 1896, was a dry hole at 1745 feet. No. 2 was drilled in 1897, and was on the pump as late as 1898.

Four Forks Claim. Six wells, Four Forks Nos. 1 to 6, inclusive. No. 3 was a producer, but was abandoned for unknown reasons in 1899. No. 4 was drilled in 1895, to 1100 feet, and was probably a failure. No. 5 was a producer, and was on the pump in 1898. No. 6 was drilled in 1898, depth 1450 feet, and was a producer.

Irwin Claim. One well, Irwin No. 1, drilled in 1896, and pumping in 1898. This claim is now under lease to the Rose Oil Company.

Spring Valley Extension Claim. Two wells, Spring Valley Nos. 1 and 2. No data.

Hawkswing Claim. Hawkswing No. 1. Drilled in 1899; depth 972 feet; still producing five barrels per day.

Junction Claim. Five wells, Junction Nos. 1 to 5, inclusive. No. 2 was abandoned in 1899, and apparently had been a producer. Nothing can be learned as to the other four.

Central Claim. Five wells, Central Nos. 1 to 5, inclusive. No. 1 was pumping in 1899, but has since been abandoned, and is said to have been exhausted. No. 2 is 650 feet deep, and is still making about one barrel per day. No. 3 is 660 feet deep, and is now making seven barrels per day. No. 4 was drilled in 1897 to 980 feet depth, and was once a producer, but now is abandoned. No. 5 was drilled in the same year, was carried to 1220 feet, but plugged off at 1010 feet, and is still producing two barrels per day.

Los Angeles Claim. The first hole, Los Angeles No. 1, was drilled by the Los Angeles Oil Company, who also drilled a hole on the Joseph Claim, in the south half of the section. The tract was then leased to the Union Oil Company, who drilled No. 1A, a test hole, dry at 1400 feet, and thereafter seven wells, now known as Los Angeles Nos. 1 to 7. Nos. 1, 2, and 3 were originally producers, drilled about 1895, still on the pump in 1897, but had been abandoned in 1899. No. 4 is still making four barrels per day. No. 5 is 1000 feet deep, and is now making one and one half barrels per day. No. 6, drilled in 1897, was a producer at 1550 feet, but has since been abandoned. No. 7 was drilled in 1898 to 1160 feet, and was a producer. It was deepened in 1899, but, if the present reported depth (1010 feet) is correct, without improvement. It is now classed as a six-barrel producer.

Kentuck Claim. Six wells, Kentuck Nos. 1 to 6. No. 1, drilled in 1890, depth 950 feet, oil at 440 feet, plugged at 500 feet. Was a producer, was still on the pump in 1897, but now dead. No 2, drilled in the same year, is reported to be about 600 feet deep and was originally rated at six barrels a day. Still producing. No. 3, drilled in the same year, is still producing—was originally rated at two barrels a day. No. 4 was abandoned when drilled. No. 5, drilled in 1897, was a producer at 600 feet, but now abandoned. No. 6, drilled in 1898, was carried to 1225 feet, but pulled back to 650 feet, and is still on the pumping list. This lease and the wells thereon passed to Clampitt Brothers in the current year.

Star Oil Claim. Six wells, Star Nos. 1 to 6. Nos. 1 to 4 are abandoned. No data. No. 5 was drilled in 1897 to 950 feet, and No. 6 in 1898 to 990 feet. These two wells are said to be good for an average of ten barrels per day each at the present time.

So far as is known, this completes the list of the Union Oil Company's operations in Tar Creek and Little Sespe. The totals are as follows:

15 wells abandoned when drilled.
2 wells pumped out in less than a year.
35 wells known to have once produced, but now exhausted or lost.
20 wells abandoned for reasons not known.
2 wells cleaning and drilling at this time (October, 1910).
12 wells pumping an average of about five barrels per day each.

86 total number of wells recorded.

Wells North of Tar Creek.

Within the past two years considerable development has taken place in the extreme north of the Sespe country, and is now actively in progress. Production has been had nearly two and one half miles north of old Tar Creek No. 20, and drilling is under way considerably to the north and west of this. It appears likely at present that valuable new territory will be opened up far back in the mountains.

Concord Petroleum Company. This company is drilling near the west line of section 6, 5–19, and about midway of the section line. In February, 1912, this well was reported to be some 500 feet deep.

Big Chief Oil Company. This company has a producing well on the Daisy claim, near the southwest corner of section 5, 5–19. This well entered oil sand at 2285 feet, but is reported to have been finished at 2387 feet. It is said to be pumping an average of 93 barrels per day of an oil approximating 17½° Beaumé.

Squaw Flat Oil Company. This company is operating on the Nogales claim, north half of the north half, section 8. In February, 1912, this well was drilling at 300 feet.

New Moody Gulch Oil Company. Is operating on the Santa Fé claim, in the northeast quarter of section 8. This well is reported to be 200 feet, drilling. This company have also a well in Moody Gulch, Santa Clara County.

Whitelaw Oil Company. Is drilling on the Shenandoah claim, in the northeast quarter of Section 17. This well is said to have reached a depth of about 2600 feet, and to have found a light oil sand below a stratum of heavy oil similar to that encountered in the Big Chief well.

Stockholders Oil Company. This company has a 1200 foot hole on the Sampson claim, in the southeast quarter of section 17. In the early part of 1912 this well was suspended at about 700 feet.

Union Oil Company—"Sunset." This company is said to be drilling on the Sunset claim, in the northwest quarter of section 21, but progress is not reported.

Wells East and South of Tar Creek Wells.

Considerable activity has also been shown in the way of eastward extensions of the old Tar Creek and Little Sespe groups, and some work has also been done on old leases.

Anaconda Oil Company. The well of this company is in the northeast quarter of section 28, and just east of the old Black Jack wells. It is suspended at about 2000 feet, with tools in the hole, and probably will have to be abandoned.

Stockholders Oil Company. This company has a 1200 foot hole on the Intervenor claim, in the southeast quarter of the same section. No work has been done on this well for a number of months.

Big Sespe Oil Company—Clampitt Bros. On the old Razzle-Dazzle claim, later known as the Oil Spouter, in section 1, 4–20. Four wells on a steep hillside just north of the bend in Sespe Cañon, in which the Kentuck wells are located. These wells were drilled by the California Oil Company, and later operated by the Big Sespe Oil Company of California. The property has lately (December, 1910) passed to Clampitt Bros. of Los Angeles.

There are at present four wells, though there appears to be a fifth, which can not now be located. The four producing wells are as follows:

No. 1—1020 feet deep, producing.
No. 2— 800 feet deep, producing.
No. 3— 930 feet deep, producing.
No. 4—1280 feet deep, producing.

Cosmopolitan Oil Company. This company is credited with three wells. No. 1, on the Wildcat claim, is a producer of 33° oil at 1800 feet. No. 2 is on the Udall claim, and produces a similar oil at 1010 feet. No. 3, also on the Udall, was drilling, and No. 4 rigged, in December, 1910.

White Star Oil Company—Oil Creek Consolidated Oil Company—Elk Consolidated Oil Company. The first named company, a consolidation of the other two, has seven wells on the Westside and Delta claims, in section 33, 5–19.

No. 1, Delta, is a 920-foot producer, drilled in 1907.

No. 2, Delta, is a producer at 2323 feet, drilled in 1908.

No. 3, Delta, was drilled in the same year, and produces from 1180 feet.

No. 4, Delta, is an 1832-foot producer, drilled in 1909.

No. 5, Westside, was drilled in 1910, and is a producer at 1827 feet.

No. 6, Westside, was a producer at 1185 feet in December, 1910, but was then in the top sand only and was to be deepened.

No. 7, Westside, was drilling at 1100 feet at the same time.

Rose Oil Company. The wells of this company are on the Irwin claim, in the southeast quarter of section 32. The abandoned well on this claim was drilled by the Union Oil Company, as noted above. Well No. 1 of the Rose Oil Company was drilled to a depth, it is said, of 2800 feet, but was not finished because of mechanical difficulties. Well No. 2 was drilling at 2600 feet in February, 1912.

Mutual Oil Company. The well of this company is on the Alhambra claim, in the southeast quarter of section 33. It is reported to have been finished at 3300 feet, in January, 1912. Considerable oil was found at about the 2000 foot level, but the productiveness of the well as finished is not known.

Oil Creek Oil Company. Is reported to have spudded in a hole on the southwest quarter of section 35, in March, 1912.

Dixie National Oil Company—Ventura-California Oil Company. On the Neptune claim, 5, 4-19. No. 1 was finished in 1910, and was reported to be doing 24 barrels per day from 2100 feet. No. 2 was finished in 1911, and is said to be a producer at about 1800 feet. The property passed to the Ventura-California Oil Company in this year.

Los Angeles Oil Company. On the Los Angeles claim, now under lease to the Union Oil Company of California. No. 1, drilled in 1890, depth 1500 feet, a dry hole. No. 2 was on the Joseph claim, now operated by the Brownstone Oil and Refining Company, drilled in 1890, a dry hole at 1100 feet.

Brownstone Oil and Refining Company. Five wells on the Joseph claim, section 6, 4–19. No. 1, drilled in 1904, 800 feet, producing. No. 2, drilled in the same year, 460 feet, producing. No. 3, drilled in 1905, about 1000 feet, producing. No. 4, same year, 1390 feet, producing. These wells were drilled and for a time operated by the Happy Thought Oil Company, and are reported to be now averaging about fifteen barrels per day each. No. 5 was 1395 feet drilling in December, 1910.

Emslie Oil Company. In 1911 the above property passed to the Emslie Oil Company. Well No. 5 has been finished.

Crown Oil Company. On the northwest quarter of the northwest quarter of section 7, 4–19. One well, 1200 feet, suspended, said to be good for ten barrels per day at this depth.

Monarch Oil Company. On the southwest quarter of northwest quarter of section 7, 4–19. A 400-foot abandoned well, drilled about 1901; no results.

Golden Gate Oil Company. This company drilled two wells on the northeast quarter of southwest quarter of the same section, at about the same time. No. 1 was abandoned at 1500 feet, and is reported to have been a dry hole. No. 2 is said to have been drilled for 300 feet only.

Montana Oil Company. At about the same time this company drilled a hole, said to be 1000 feet deep, on the southeast quarter of southwest quarter of the same section. It was reported at the time that some oil had been found, but how much can not now be learned.

Skookum Oil Company, or Webfoot Oil Syndicate. One of these corporations drilled in 1902, west of Pole Cañon, near the north line of section 8, 4–19. Depth 1000 feet, no oil, but much water.

Golden West Crude Oil Company. This company drilled the well near the mouth of Pole Cañon, on the hill north of the creek. The well entered a tarry formation at 200 feet, and penetrated it to a depth of

440 feet, when it was abandoned. This well was drilled on a small cropping of asphaltic oil sand.

Black Pearl Oil Company. The well of this company was immediately south of the creek, near the mouth of Pole Cañon. It was drilled in 1910, to a depth of 1000 feet, and found small quantities of oil, but not a profitable amount. This well is still rigged.

Union Consolidated Oil Company. Is said to have drilled the hole in the north half, north half of section 29. No record of this well can be found.

Whittier-Fillmore Oil Company. Two abandoned wells in the same section, close to the grant line and just north of the county road. There is a cropping of oil sand in the bank at this point, and the two wells, which were 500 and 700 feet, respectively, found a small amount of oil, but no pay. This company afterward operated successfully in the Whittier field.

QUALITIES OF SESPE OILS.

The Sespe territory produces many grades of crude, which may be gathered into three classes: a very heavy black oil, giving no light products, and useful only as fuel; a medium black oil, ranging from 19° to 23°, giving low to fair yields of light products; and a very light black oil, giving a high yield of naphthas.

The heaviest oil is found in Big Sespe only. The medium grade was produced by some of the Tar Creek wells (which ones cannot now be learned), and is the present output of the wells in the forks of Big and Little Sespe cañons—the Kentuck and Clampitt wells. It was also found in some of the Four Forks wells, and probably in many other wells close to the outcrop of the sand. The lightest grade is found farther back on the formation, and while the number of samples does not justify much generalization, it is probable that the gravity increases, within limits, as drilling is carried down the dip.

These lightest oils are among the highest grade refining oils of the State, giving very large yields of naphthas and illuminants, and these of good quality. The heavy end of the crude oil is, as a rule, practically valueless except for fuel, because of the high cold test of the lubricants made from it. As with the Bardsdale oils. these crudes contain much amorphous paraffin, which cannot be filtered out, as it will not crystallize.

The following analyses probably cover completely the range of values of the oils of this district:

5469.*

Big Sespe Oil Company of Arizona. Wells No. 1 and No. 4.

Gravity ---------- approximately 13° Beaumé

This is a very viscous black oil, and frothed so badly that it was finally dried by evaporation at the lowest possible temperature in an open pan. With any ordinary oil of this viscosity and gravity, there is no danger of the loss of any volatile elements in this process. The dried oil was then distilled.

Distillation.

A sample of 108 c.c., distilled from copper in a current of gas, distillation being carried to dry coke. The first ten per cent of the distillate showed a gravity of 27° Beaumé, so that there may have been a small amount of stove oil which escaped measurement.

Distillate ----------	83.3 per cent	21.7° Beaumé
Fixed carbon ----------	16.0 grams per 100 c.c.	
Loss ----------	0.7 per cent	
	100.0 per cent	

The carbon was calculated to "D" asphalt in the usual manner, and the distillate reduced in a current of gas, giving the following commercial analysis:

Gasoline ----------	61.0° Beaumé	None
Engine distillate ----------	52.0°	None
Kerosene ----------	42.0°	None
Stove oil ----------	33.0°	None or trace
Fuel distillate ----------	31.0°	22.2 per cent) Slop distillate
Reduced stock ----------	13.6°	37.1 per cent) 21.7°—59.3 %
Asphalt ----------	"D"	40.0 per cent or 140.4 lbs. per bbl.
		100.0 per cent

The reduced stock is of a light color, with a good green outertone, and a high viscosity, but shows no paraffin. On treatment it gives a light-colored red oil of 16.1° Beaumé, having a rich green outer tone, and a viscosity normal to red oils of this gravity.

This crude in every respect resembles the heavy oils of the San Joaquin Valley, and has none of the characteristics which distinguish Ventura from other crudes.

7464.†

Union Oil Company. Tar Creek. "A" Well.

Gravity ---------- 38.0° Beaumé (0.833 sp. gr.)

This sample of oil was collected and analyzed in the year 1886, and nothing is recorded as to the appearance of the oil, nor, unfortunately, as to the number or location of the well from which it was taken.

The gravity given for the crude does not agree at all with the analysis, and is decidedly under suspicion of being a misprint.

Distillation.

A sample of 500 c.c. was distilled from a copper retort, the thermometer bulb being set in the neck of the retort (probably). No steam or gas was

*Analysis by P. W. P.

†Analysis by Dr. W. D. Johnston.

used to assist distillation, which was carried up to 300° C., and nothing is recorded as to the properties of the residue.

Below 100° C.	10.0 per cent	64.4° Beaumé
100 to 125°	6.8 per cent	55.4°
125 to 150°	5.5 per cent	50.1°
150 to 200°	9.7 per cent	43.0°
200 to 250°	11.0 per cent	33.5°
250 to 300°	7.1 per cent	27.4°
Residue	49.9 per cent	Not recorded
	100.0 per cent	

This is approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	16 per cent
Engine distillate	52°	5 per cent.
Kerosene	42°	13 per cent
Stove oil	33°	9 per cent
Middlings (top only)	28°	7 per cent
Residue	---	50 per cent
		100 per cent

7465.*

Union Oil Company. Tar Creek. Well No. 2.

Gravity 33.0° Beaumé (0.859 sp. gr.)

This sample of oil was collected and analyzed in the year 1886, and nothing is recorded as to the appearance of the oil.

Distillation.

A sample of 500 c.c. was distilled from a copper retort, without the use of either steam or gas. Distillation was carried up to a temperature of 300° C., but nothing is recorded as to the properties of the residue.

Below 100° C.	9.1 per cent	70.0° Beaumé
100 to 125°	9.2 per cent	60.7°
125 to 150°	8.8 per cent	58.7°
150 to 200°	11.8 per cent	45.4°
200 to 250°	9.0 per cent	40.3°
250 to 300°	8.0 per cent	29.8°
Residue	44.1 per cent	Not recorded
	100.0 per cent	

This is approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	28 per cent
Engine distillate	52°	None
Kerosene	42°	23 per cent
Stove oil	33°	None
Middlings (top only)	28°	5 per cent
Residue	---	44 per cent
		100 per cent

This sample shows a phenomenon noted also in 5479 and 7418, both gasoline and stove oil being completely cut out by the over-running of adjacent fractions. Both these products could be made by altering the cuts on the crude.

*Analysis by Dr. W. D. Johnston.

7484.*

Union Oil Company. Tar Creek. "A" Well.

Gravity ----------23.4° Beaumé (0.9125 sp. gr.)

This sample of oil was collected and analyzed in the year 1895, and nothing is recorded as to the appearance of the oil, nor as to the number or location of the well from which it was taken.

Distillation.

This sample was distilled dry, from a glass flask or retort, but no details as to methods are given.

Below 150° C.	7.6 per cent	60.4° Beaumé
150 to 200°	11.0 per cent	54.3°
200 to 250°	10.4 per cent	40.7°
250 to 300°	12.4 per cent	34.4°
300 to 350°	6.0 per cent	28.5°
Residue	52.6 per cent	Not recorded
	100.0 per cent	

This is approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	7.0 per cent
Engine distillate	52°	15.5 per cent
Kerosene	42°	2.5 per cent
Stove oil	33°	22.0 per cent
Residue	---	53.0 per cent
		100.0 per cent

In this case the very low yield of stove oil is caused by the narrow cut on gasoline, which starts the engine distillate unusually high, and makes it cut into the kerosene stock at the upper end. It is necessary to state the results in this way for the sake of uniformity, but in actual running other cuts would probably be made.

7485.*

Union Oil Company. Tar Creek. "A" Well.

Gravity ----------23.3° Beaumé (0.9192 sp. gr.)

This sample of oil was collected and analyzed in the year 1895, and nothing is recorded as to the appearance of the oil, nor as to the number or location of the well from which it was taken.

Distillation.

This sample was distilled dry, from a glass flask or retort, but no details as to methods are given.

Below 150° C.	8.4 per cent	63.3° Beaumé
150 to 200°	8.0 per cent	58.4°
200 to 250°	10.4 per cent	45.3°
250 to 300°	14.2 per cent	32.7°
300 to 350°	4.0 per cent	Not recorded
Residue	55.0 per cent	Not recorded
	100.0 per cent	

*Analysis by W. L. Watts.

This is closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	16.4 per cent
Engine distillate	52°	None
Kerosene	42°	15.5 per cent
Stove oil	33°	5.0 per cent
Middlings (top only)	---	8.1 per cent
Residue	---	55.0 per cent
		100.0 per cent

This oil cuts very peculiarly, and the sudden drop between the second and third fractions is open to suspicion, particularly in view of the fact that the results, as originally stated, did not include any residue, and there is therefore a possibility of an intermediate fraction having been dropped. As no samples of these oils are now obtainable, the work can not be checked, but at least the first two cuts are correct.

7487.*

Union Oil Company. Kentuck Lease. "A" Well.

Gravity ---------- 25.3° Beaumé (0.9015 sp. gr.)

This sample of oil was collected and analyzed in the year 1895. The number of the well from which the sample was taken is not given.

Distillation.

This sample was distilled dry, from a glass flask or retort, but no details as to methods are stated.

Below 150° C.	6.0 per cent	64.4° Beaumé
150 to 200°	8.6 per cent	54.2°
200 to 250°	10.0 per cent	44.0°
250 to 300°	12.2 per cent	35.7°
300 to 350°	2.5 per cent	31.6°
Residue	60.7 per cent	Not recorded
	100.0 per cent	

This is closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	10.0 per cent
Engine distillate	52°	4.6 per cent
Kerosene	42°	16.0 per cent
Stove oil	33°	8.7 per cent
Residue	---	60.7 per cent
		100.0 per cent

This sample should be compared with No. 4490.

4490.†

Union Oil Company. Kentuck Claim. Wells No. 2 and No. 3.

Gravity ---------- 22.1° Beaumé

This is an oil of a blackish-brown color, somewhat more limpid than the Razzle-Dazzle oil, but of the same sweet and aromatic odor.

*Analysis by W. L. Watts.

†Analysis by J. P. P.

Distillation.

A sample of 140 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	5.5 per cent	60.8° Beaumé
Second cut	6.2 per cent	52.1°
Third cut	11.6 per cent	42.0°
Fourth cut	22.1 per cent	33.5°
Fifth cut	48.7 per cent	24.5°
Fixed carbon	5.9 grams per 100 c.c.	
	100.0 per cent	

The lubricating stock from this oil was not rerun. On calculation of carbon to asphalt, the following commercial analysis is shown:

Gasoline	61.0° Beaumé	6.0 per cent
Engine distillate	52.0°	6.0 per cent
Kerosene	42.0°	11.5 per cent
Stove oil	33.0°	23.0 per cent
Lubricating stock	24.5°	38.7 per cent
Asphalt	"D"	14.8 per cent or 51.9 lbs. per bbl.
		100.0 per cent

The light products from this crude are high in quantity for an oil of this gravity, and refine readily to white and sweet oils. The heavy end of the oil appears to be very similar to that from other oils of this neighborhood, and of little value.

7488.*

California Oil Company (now Clampitt Bros.). Razzle-Dazzle Wells.

Gravity ---------- 18.9° Beaumé (0.9402 sp. gr.)

This sample was collected and analyzed in the year 1895. The number of the well from which the sample was taken is not stated, but it is probable that the oil was the average from the four wells then in operation.

Distillation.

This sample was distilled dry, from glass flask or retort, but no details as to methods are given.

Below 150° C.	Traces	
150 to 200°	7.3 per cent	53.3° Beaumé
200 to 250°	9.5 per cent	44.7°
250 to 300°	11.3 per cent	34.7°
300 to 350°	2.9 per cent	32.7°
Residue	69.0 per cent	Not recorded
	100.0 per cent	

This is closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	10.0 per cent
Kerosene	42°	7.5 per cent
Stove oil	33°	13.5 per cent
Residue	---	69.0 per cent
		100.0 per cent

*Analysis by W. L. Watts.

4487.*

Clampitt Brothers. Razzle-Dazzle Wells. Average.

Gravity ---------- 19.3° Beaumé.

This is a brownish-black oil of a moderate viscosity, considerably higher than that of the oils farther east and north. The odor is sweet, but decidedly aromatic.

Distillation.

A sample of 140 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut ----------	5.5 per cent	51.9° Beaumé
Second cut ----------	12.8 per cent	41.4°
Third cut ----------	10.2 per cent	32.7°
Fourth cut ----------	64.5 per cent	23.1°
Fixed carbon ----------	7.0 grams per 100 c.c.	
	100.0 per cent	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of gas. This gives the following commercial analysis:

Gasoline ----------	61.0° Beaumé	None
Engiue distillate ----------	52.0°	5.5 per cent
Kerosene ----------	42.0°	12.0 per cent
Stove oil ----------	33.0°	11.0 per cent
Fuel distillate ----------	29.4°	29.7 per cent } Slop distillate
Reduced stock ----------	16.1°	24.3 per cent } 23.1°—54.0%
Asphalt ----------	"D"	17.5 per cent or 61.5 lbs. per bbl.
		100.0 per cent

The light products from this oil, while small in quantity, are at least up to the average for an oil of this gravity, and are very mild and sweet, and of good colors, after treatment.

The lubricating stock reduced to a stock of good green color, which was somewhat mushy with paraffin, though much less so than the stock from the lighter oils. This reduced stock treated out to an engine oil of light-red color and fine green outer tone, having the gravity 17.7°, and a viscosity normal to the gravity, but solidifying at 65° Beaumé. It is probably possible to handle this oil in the crude still as to somewhat lower the cold test of the engine oil, though this would be high at the best.

4465.*

Union Oil Company. Central Claim. Well No. 3.

Gravity ---------- 29.1° Beaumé

This is a fairly limpid, brownish-black oil, with a penetrating and somewhat aromatic, but not sulfurous odor. In spite of its low viscosity it shows a slight tendency to emulsify with water.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

*Anaylsis by J. P. P.

First cut	8.9 per cent	61.9° Beaumé
Second cut	8.8 per cent	51.4°
Third cut	16.1 per cent	42.3°
Fourth cut	31.5 per cent	33.0°
Fifth cut	29.4 per cent	25.3°
Fixed carbon	5.3 grams per 100 c.c.	
	100.0 per cent	

The lubricating stock from this distillation was too small in quantity to be rerun. After calculation of the asphalt, the following commercial analysis is shown:

Gasoline	61.0° Beaumé	10.0 per cent
Engine distillate	52.0°	6.0 per cent
Kerosene	42.0°	19.5 per cent
Stove oil	33.0°	30.0 per cent
Lubricating stock	25.3°	21.2 per cent
Asphalt	"D"	13.3 per cent or 46.7 lbs. per bbl.
		100.0 per cent

The abnormal yield of stove oil from this crude is caused by decomposition, which has also affected the lubricating stock to some extent, and would be lessened in steam distillation. Nevertheless, the stock appears to contain too much amorphous paraffin to be of much value for lubricants, and the value of the crude lies at the light end. The light products take the acid only fairly well, contrary to the rule with oils from this territory.

4477.*

Union Oil Company. Star Claim. Wells No. 4 and No. 5.

Gravity ..... 27.5° Beaumé

This is a moderately limpid, brownish-black oil, with a sweet and rather penetrating odor. There is no tendency to emulsification with water.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	6.3 per cent	62.9° Beaumé
Second cut	7.0 per cent	51.7°
Third cut	17.1 per cent	42.1°
Fourth cut	12.6 per cent	33.0°
Fifth cut	52.4 per cent	28.4°
Fixed carbon	4.6 grams per 100 c.c.	
	100.0 per cent	

*Anaylsis by J. P. P.

These figures are equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	8.5 per cent	
Engine distillate	52.0°	2.5 per cent	
Kerosene	42.0°	17.5 per cent	
Stove oil	33.0°	14.5 per cent	
Fuel distillate	31.0°	18.9 per cent	Slop distillate
Reduced stock	18.7°	26.6 per cent	28.4°—45.5%
Asphalt	"D"	11.5 per cent or 40.4 lbs. per bbl.	
		100.0 per cent	

The light products from this crude refined only fairly well, giving good sweet odors, but only fair colors. It will be noted that the yield of stove oil is normal, and does not indicate decomposition of the heavy end, as in the case of the Central sample. Still, the gravity of the lubricating stock is very high, and while the reduced stock treats out to a red oil of very fair color, this solidifies at 70° F., which would indicate that the heavy end of the crude is of little value.

4479.*

Union Oil Company. Hawkswing Claim. Well No. 1.

Gravity ---------- 29.4° Beaumé

This is a brownish-black oil, slightly less limpid than the preceding samples, with a sweet and rather flat odor.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	9.0 per cent	61.8° Beaumé
Second cut	8.0 per cent	51.9°
Third cut	14.0 per cent	41.8°
Fourth cut	22.0 per cent	33.0°
Fifth cut	40.6 per cent	27.4°
Fixed carbon	5.6 grams per 100 c.c.	
	100.0 per cent	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	10.0 per cent	
Engine distillate	52.0°	6.0 per cent	
Kerosene	42.0°	16.0 per cent	
Stove oil	33.0°	20.0 per cent	
Fuel distillate	29.8°	19.8 per cent	Slop distillate
Reduced stock	Solid	13.2 per cent	27.4°—33.0%
Asphalt	"D"	14.0 per cent or 49.1 lbs. per bbl.	
		100.0 per cent	

*Anaylsis by J. P. P.

The light products from this crude refined readily, the test acid giving water-white and sweet products. The stove oil, which is rather large in quantity, was rank, and evidently burned. The lubricating stock was very black, after reduction, and did not take the acid well, giving a dark-green treated product, which was entirely solid up to nearly 100° F.

4491.*

Union Oil Company. Los Angeles Lease. Wells Nos. 4, 5 and 7.

Gravity ..... 30.3° Beaumé

This is a limpid oil of a brownish-black color, and a sweet, aromatic odor.

Distillation.

A sample of 140 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	9.9 per cent	63.2° Beaumé
Second cut	8.0 per cent	52.4°
Third cut	15.0 per cent	42.0°
Fourth cut	21.2 per cent	33.3°
Fifth cut	39.7 per cent	28.1°
Fixed carbon	6.2 grams per 100 c.c.	
	100.0 per cent	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a current of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	13.0 per cent
Engine distillate	52.0°	3.0 per cent
Kerosene	42.0°	19.0 per cent
Stove oil	33.0°	19.0 per cent
Fuel distillate	31.7°	19.2 per cent
Reduced stock	Pasty	11.3 per cent
Asphalt	"D"	15.5 per cent or 54.4 lbs. per bbl.
		100.0 per cent

The light products from this crude treated out in a satisfactory manner, giving sweet oils of at least fair color. The lubricating stock contains too much paraffin to be of much value, and breaks down a good deal in distillation.

7418.†

Union Oil Company. Los Angeles Lease. Well No. 7.

Gravity ..... 30.9° Beaumé
Viscosity at 60° F. ..... 2.79 Redwood (water—1)
Viscosity at 180° F. ..... 1.66 Redwood (water—1)
Flash point ..... Below 60° F., Abel-Pensky test

*Anaylsis by J. P. P.
†Analysis by H. N. Cooper.

Distillation.

Sample of 200 c.c. distilled from glass still, dry, no steam or gas.

Below 212° F.	9.3 per cent	68.4° Beaumé
212 to 302°	10.2 per cent	53.7°
302 to 392°	9.8 per cent	45.2°
392 to 482°	8.8 per cent	39.1°
482 to 572°	11.4 per cent	33.4°
572° to grade	34.9 per cent	29.7°
Asphalt	13.2 per cent	Grade "D" (about)
Loss	2.4 per cent	
	100.0 per cent	

This is roughly equal to the following commercial analysis:

Gasoline	61° Beaumé	19 per cent
Engine distillate	52°	None
Kerosene	42°	19 per cent
Stove oil	33°	12 per cent
Fuel distillate and lubricants	28°	35 per cent (not separated)
Asphalt	--	13 per cent
Loss	---	22 per cent
		100 per cent

Nothing is recorded as to the quality of the products from this oil. The gasoline runs much higher than in No. 4491, but otherwise the two analyses correspond closely.

5478.*

Brownstone Oil and Refining Company. Wells Nos. 1, 2, 3 and 4.

Gravity ---------- 25.5° Beaumé

This is a limpid, brownish-black oil, of a highly sulfurous odor. It shows considerable tendency to emulsify with water.

Distillation.

A sample of 119 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	8.0 per cent	58.6° Beaumé
Second cut	6.3 per cent	51.9°
Third cut	12.5 per cent	42.0°
Fourth cut	11.1 per cent	33.8°
Fifth cut	55.8 per cent	25.6°
Fixed carbon	6.3 grams per 100 c.c.	
	100.0 per cent	

The carbon was calculated to asphalt in the usual manner, but the lubricating stock was not reduced. The following commercial analysis is shown:

Gasoline	61.0° Beaumé	5.0 per cent
Engine distillate	52.0°	12.0 per cent
Kerosene	42.0°	8.0 per cent
Stove oil	33.0°	15.0 per cent
Lubricating stock	25.6°	44.2 per cent
Asphalt	"D"	15.8 per cent or 55.5 lbs. per bbl.
		100.0 per cent

*Analysis by P. W. P.

The light products from this crude take treatment readily, and give white and very sweet oils. The lubricating stock is of high gravity and low viscosity, and is probably of little value.

7486.*

Union Oil Company. Four Forks Claim. "A" Well.

Gravity ---------- 22.2° Beaumé (0.9196 sp. gr.)

This sample of oil was collected and analyzed in the year 1895. The number of the well from which the sample was taken is not given.

Distillation.

This sample was distilled dry, from a glass flask or retort, but no details as to methods are given.

Below 150° C.	Traces	
150 to 200°	16.9 per cent	52.2° Beaumé
200 to 250°	16.8 per cent	44.9°
250 to 300°	9.7 per cent	37.3°
300 to 350°	6.6 per cent	32.7°
Residue	60.0 per cent	Not recorded
	100.0 per cent	

This is closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	7.0 per cent
Kerosene	42°	26.5 per cent
Stove oil	33°	6.0 per cent
Residue	---	60.5 per cent
		100.0 per cent

5479.†

Cosmopolitan Oil Company. Udall Lease. Well No. 2.

Gravity ---------- 34.5° Beaumé

This is a very limpid, brownish-colored oil, with a mild and ethereal odor. It is the lightest crude, so far as is known, produced in the Sespe country.

Distillation.

A sample of 80 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	29.7 per cent	61.0° Beaumé
Second cut	20.7 per cent	41.7°
Third cut	16.5 per cent	29.6°
Fourth cut	30.3 per cent	17.7°
Fixed carbon	2.8 grams per	100 c.c.
	100.0 per cent	

The volume of lubricating stock from this run was too small for redis-

*Analysis by W. L. Watts.

†Analysis by J. P. P.

tillation. The carbon was calculated to "D" asphalt, giving the following commercial analysis:

Gasoline	61.0° Beaumé	30.0 per cent
Engine distillate	52.0°	None
Kerosene	42.0°	20.0 per cent
Stove oil	33.0°	10.0 per cent (approximately)
Lubricating stock	17.7°	33.0 per cent
Asphalt	"D"	7.0 per cent or 24.6 lbs. per bbl.
		100.0 per cent

The first two cuts from this crude were pale and sweet, and took treatment very readily. The third cut had a most unusual ethereal and acetic odor, which was practically unchanged by treatment. The lubricating stock was of good color, and as will be noted, had an unusually low gravity for an oil run in this manner, and a correspondingly high viscosity. No paraffin was noted in this stock.

The absence of 52° distillate from this crude is due simply to the fact that the gasoline started at so high a gravity, that all the 52° had to be fed into this cut to bring the average down to 61°. By cutting off the top of the gasoline, a normal yield of 52° could be had.

5485.*

White Star Oil Company. Wells Nos. 4 and 5.

Gravity ..... 33.7° Beaumé

This is a moderately limpid, brownish-black oil, with a mild odor. At about 60° F. it sets to a jelly-like consistency, by the separation of amorphous paraffin.

Distillation.

A sample of 100 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	19.8 per cent	61.0° Beaumé
Second cut	10.2 per cent	52.0°
Third cut	15.6 per cent	38.0°
Fourth cut	19.8 per cent	32.8°
Fifth cut	28.8 per cent	Solid
Fixed carbon	5.8 grams per 100 c.c.	
	100.0 per cent	

The lubricating stock was not redistilled. Carbon calculated to asphalt as usual, giving the following commercial analysis for the crude:

Gasoline	61° Beaumé	20.0 per cent
Engine distillate	52°	10.0 per cent
Kerosene	42°	11.0 per cent (approximately)
Stove oil	33°	25.0 per cent
Lubricating stock	Solid	19.5 per cent
Asphalt	"D"	14.5 per cent or 50.9 lbs. per bbl.
		100.0 per cent

*Analysis by P. W. P.

The light products from this crude treat out to good colors and odors, and are of entirely satisfactory quality. The lubricating stock, if it may be so called, was a stiff paste, but even more of a jelly than is usual with these oils carrying amorphous paraffin It is, of course, entirely valueless for the manufacture of lubricants in the ordinary manner. The difference between the behavior of this crude, and that from the Cosmopolitan wells of nearly the same gravity, is very striking.

HOPPER CANYON WELLS.

The earlier wells in Hopper Cañon were drilled many years ago, and appear to be located in broken ground adjacent to a main north and south fault, which has, in a general way, determined the location of this cañon. Later work has been done to the south and east of the old wells, resulting in fairly good yields of lighter oil, apparently from formations in place, and at a greater depth. Little is recorded as to the old wells, which, however, are of no very great interest at the present time.

San Cayetano Oil Company—Oil King Company. The most northerly well in this cañon was drilled by the San Cayetano Oil Company, on the east side of the main cañon, in the northeast quarter of section 1. This well was drilled in 1900, was 600 feet deep, and yielded some gas, but no oil. Later this property was leased to the Oil King Company, who drilled two wells, on the west side of the cañon, and in the southwest quarter of the section. The numbers of these wells are uncertain, but the more northerly was only 160 feet deep, and the southern 600. Neither is known to have yielded any oil.

Sunset Oil Company. The wells of the Sunset Oil Company of Los Angeles are all on the northeast quarter of section 12. The first of these wells was drilled in 1889, and the balance soon thereafter. No. 1 was a spoiled hole at 900 feet, No. 2 is a producer at 300 feet, No. 3 was a dry hole, depth not known. No. 4 is a producer, and something over 1000 feet deep. No. 5 was abandoned. No. 6 is a 700-foot producer, and No. 7 produces from the 600-foot level. No. 8 was a dry hole, depth not recorded. No. 9 is a 700-foot producer. No. 10 was abandoned at 700 feet because of shifting sand, and No. 11 at the same depth, as a dry hole.

The five producing wells pump by heads, making some seven barrels of a black oil approximating 14° Beaumé.

Buckhorn Oil and Transportation Company—C. C. Harris Oil Company. The former company originally owned and operated a group of seventeen shallow wells, lying in the turn in Hopper Cañon, on the west half of northwest quarter of section 13, and the east half of northeast quarter of section 14. These wells lie on both sides of the cañon, and eight of the seventeen are still on the jack, and making a small amount of heavy oil. The records, so far as now obtainable, are as follows:

No. 1, a spring-pole hole, drilled in 1884 to a depth of 85 feet only. This hole produced in all 800 barrels of a 12° oil, then choked and was abandoned.

No. 2, drilled in 1887, depth 90 feet—producing.

No. 3, drilled in 1887, abandoned because of crooked hole at 150 feet, with some oil.

No. 4, drilled in 1888. A 200-foot water well.

No. 5, drilled in 1888 to a depth of 450 feet. This well was originally good for 40 barrels per day.

No. 6, drilled in 1888, crooked hole at 150 feet.

No. 7, drilled in 1888, crooked hole at 250 feet.

No. 8, drilled in 1888, a producer of very heavy oil at 400 feet.

No. 9, abandoned, no data.

No. 10, abandoned, no data.

No. 11, producer, no data.

No. 12, drilled in 1889, producer, less than 100 feet deep.

No. 13, drilled in 1889, a 400-foot producer.

No. 14, a 250-foot water well.

No. 15, drilled in 1889, depth 900 feet, initial production 10 barrels.

No. 16, depth 1100 feet, initial production 30 barrels of 17° oil.

No. 17, depth 700 feet, abandoned.

These wells are now the property of the C. C. Harris Oil Company.

H. G. Cates Estate has four producing and two drilling wells. No. 1 is just east of the old holes, was drilled in 1904, is 1400 feet deep, and is a producer. No. 2, north of No. 1, was drilled in 1908 to a depth of 1500 feet, and is a producer. No. 3 is near the northeast corner of the northwest quarter, was drilled in 1909, and is a producer at about 1500 feet. No. 5 is southeast of No. 3, was drilled in the same year, and is a producer at 2222 feet. No. 7, in the northeast quarter of this section, is drilling.

Ibex Oil Company. This company has two drilling wells, No. 6, near the northeast corner of the southwest quarter, and No. 8, at the southeast corner of section 12.

C. C. Harris Oil Company—Boulder Creek Land & Oil Company. The hole in the northwest corner of the northeast quarter of section 24 was drilled by the C. C. Harris Oil Company in 1911. This well is a producer at 960 feet, and is said to be doing 25 barrels daily. The lease and well have lately passed to Boulder Creek Land & Oil Company.

Bradley Oil Company. This company drilled two wells on the Cañon claim, the west half of the southwest quarter of section 13. No. 1, near the southeast corner of this tract, was drilled in 1900, and is a dry hole at 1100 feet. No. 2, on the west line of the section, and the east side of the cañon, was drilled in 1901, and is a dry hole at 800 feet.

St. Louis Oil Company. In 1901 this company drilled a 1000-foot hole on the north side of Toms Cañon, near the southwest corner of section 14. This hole is reported to have been quite barren.

Buckhorn Oil and Mining Company. On the Shirley Wilson tract, the east half of the southeast quarter of section 23, in the hills west of Hopper Cañon. No. 1, 300 feet, dry hole; No. 2, 280 feet, dry hole; No. 3, 800 feet, with some gas.

United Oil Company. This company drilled in the year 1902, in the hills facing the Santa Clara Valley, west of the mouth of Hopper Cañon. This well is said to be 1200 feet deep, and is variously reported to have been a dry hole, and to have shown some oil.

Southland Oil Company. The well of this company, drilled in 1900, is on the east side of Fairview Cañon, just north of the south line of section 22. This well is something over 1000 feet deep; it is reported as a dry hole.

Other reports state that this well is only 600 feet deep. It is flowing water and traces of black, very heavy oil.

Union Oil Company of California. About 1893 this company is said to have drilled a well of considerable depth in Fairview Cañon. This hole can not now be located.

Tapo Oil Company. This corporation are reported to have drilled in the years 1901 and 1902, on the northeast quarter of the northwest quarter of section 13, 4–19, just northeast of the Fortuna wells (Buckhorn Oil and Transportation Company). This well can not now be located.

QUALITY OF HOPPER CAÑON OILS.

All the Hopper Cañon oils are of a heavy fuel grade, running from 14° to 15.5° Beaumé. These oils closely resemble San Joaquin Valley oils of the same gravity, giving a large yield of asphalt, and of lubricants, the latter being of high viscosity and cold test.

Under present market conditions, none of these oils can be considered refining oils. As produced they contain, as a rule, considerable water, which does not emulsify, but settles readily on heating.

5467.*

Sunset Oil Company. Wells No. 6 and No. 9.

Gravity ---------- 14.0° Beaumé

This is a moderately viscous oil, of a brownish color, and with a sweet and slightly sulfurous odor. This oil is somewhat less viscous than a Valley oil of corresponding gravity.

*Analysis by J. P. P.

Distillation.

A sample of 130 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation continued to dry coke.

First cut	6.5 per cent	39.3° Beaumé
Second cut	13.4 per cent	30.3°
Third cut	69.1 per cent	19.2°
Fixed carbon	11.0 grams per 100 c.c.	
	100.0 per cent	

Last fraction of distillate rerun in a stream of gas, and carbon calculated to asphalt. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	None
Kerosene	42.0°	3.0 per cent
Stove oil	33.0°	17.0 per cent
Fuel distillate	28.7°	21.0 per cent ⎫ Slop distillate
Reduced stock	13.2°	31.5 per cent ⎭ 19.2°—52.5%
Asphalt	"D"	27.5 per cent or 96.5 lbs. per bbl.
		100.0 per cent

The small quantity of kerosene was of fair color only, and the stove oil had a sour odor, which treatment did not much improve. The lubricating stock was of low gravity and excellent color, and broke down very little in distillation. The reduced stock was also of good color, and viscous, but on treatment the viscosity broke badly, and the red oil, at a gravity of 15.9° Beaumé, was much below the viscosity normal to that weight. As the percentage of asphalt is rather low, this oil is, on the whole, of little refining value.

5468.*

Aloha Oil Company. Center Wells.

Gravity ---------- 15.2° Beaumé

This is a brownish oil, of a viscosity rather low for this gravity. The odor is very sweet.

Distillation.

A sample of 150 c.c., distilled from copper, first cut dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	10.5 per cent	31.0° Beaumé
Second cut	81.9 per cent	21.0°
Fixed carbon	5.8 grams per 100 c.c.	
Loss	1.8 per cent	
	100.0 per cent	

*Analysis by P. W. P.

Second cut was reduced in a current of gas, and carbon calculated to asphalt in the usual manner, giving the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	None	
Kerosene	42.0°	None	
Stove oil[1]	33.0°	8.0 per cent	
Fuel distillate	29.0°	25.3 per cent	Slop distillate
Reduced stock	14.7°	52.2 per cent	21.0°—77.5%
Asphalt	"D"	14.5 per cent or 50.9 lbs. per bbl.	
		100.0 per cent	

The lubricating stock was of low gravity, good color, and fair viscosity, and gave a reduced stock of the same properties. The red oil was of rather deep color, with a high viscosity and low cold test, and of 16.2° Beaumé. The percentage of asphalt is very low for an oil of this gravity, and undoubtedly accounts for the unusually low viscosity of the crude.

5477.*

Aloha Oil Company. Wells Nos. 1, 2 and 3.

Gravity ..... 15.1° Beaumé

This is a more viscous oil than No. 5466, is even more brownish in color, and has the same sickening sweet odor.

Distillation.

Sample of 150 c.c., distilled from copper, in a current of gas. Distillation carried to dry coke.

First cut	5.2 per cent	33.0° Beaumé
Second cut	87.2 per cent	21.8°
Fixed carbon	7.6 grams per 100 c.c.	
	100.0 per cent	

Second cut reduced in a stream of gas, and carbon calculated to asphalt in the usual manner, giving the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	None	
Kerosene	42.0°	None	
Stove oil	33.0°	5.2 per cent	
Fuel distillate	29.4°	30.3 per cent	Slop distillate
Reduced stock	14.5°	45.5 per cent	21.8°—75.8%
Asphalt	"D"	19.0 per cent	
		100.0 per cent	

This oil shows a little more asphalt than the preceding sample, though the yield is still very low for an oil of this gravity. The lubricating stock is of good color and odor, and gives a reduced stock of low gravity and high viscosity. These oils are free from paraffin.

*Analysis by J. P. P.

7420.*

C. C. Harris Oil Company. Fortuna No. 15.

Gravity ---------- 14.6° Beaumé
Viscosity at 180° F. ---------- 4.20° Redwood

Distillation.

Sample of 200 c.c., distilled from glass flask, without the use of steam or gas.

Below 392° F.	5.9 per cent	32.6° Beaumé
392 to 482°	15.3 per cent	27.5°
482 to 572°	6.0 per cent	----
572 to grade—a	23.7 per cent	22.9°
572 to grade—b	16.7 per cent	20.4°
Asphalt	23.0 per cent	Grade doubtful
Loss	0.1 per cent	
Water	9.3 per cent	
	100.0 per cent	

Eliminating the water, this is roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	6.0 per cent
Fuel distillate and lubricants	22°	68.0 per cent (not separated)
Asphalt	---	26.0 per cent
		100.0 per cent

It will be noted that even when distilled in this manner, the worst possible for the preservation of the lubricating stock, this is still of a very low gravity. The freedom from decomposition of these crudes is probably due to lack of paraffin.

*Analysis by H. N. Cooper.

CHAPTER VI.

THE BARDSDALE WELLS.

Townships 3-20 and 3-19.

The only developments in these townships are the group known as the Bardsdale wells, in sections 11 and 12, 3–20, and in 6 and 7 in 3–19, with a few prospect holes scattered along the Santa Clara face of the ridge, east and west of these.

The hills known as Oak Ridge rise quite abruptly on the south side of Santa Clara Valley, but are less precipitous than are the hills further east. The south side of these hills, that is, the side toward Simi Valley, is rounded and rolling, but the Santa Clara side is steep enough to make access difficult except through the cañons.

The formations of the main ridge dip very uniformly to the south, *i. e.*, to the Simi side, to which fact is due the more gentle slope of this face. These formations crop in the higher faces along a line closely parallel to the south line of the Sespe tract, but somewhat further to the south, roughly half a mile. The foot of these cliffs is covered, but it appears likely at least that this line represents a long and profound fault, upthrust at the south side, and extending across both townships.

North of this fault line the formation dips to the north and disappears beneath the valley wash, but at a less angle. This north-dipping formation is of later age than that to the south, and of softer rock, and we thus have, over most of this distance, a secondary chain of low rounded hills lying against the foot of the higher and more rugged hills into which the south-dipping rocks are carved. This arrangement bears a general similarity to an anticline, as we have two sets of strata dipping away from each other, but as the apparent arch is faulted down its axis, and one of its limbs raised much above the other, the anticlinal structure proper is lacking, and the rules normally applying to such structure do not follow here.

These wells are all, so far as known, in the north-dipping formation, and the opposite limb is not known to be productive, within the limits of this township. As it is productive, however, a little further to the east (see Torrey wells), it is by no means impossible that it may be at this point also.

Bardsdale Wells.

The Union Oil Company of California have been operating this territory for many years, and, with the exception of two later companies, the Bardsdale Crude Oil Company and the Lapp-Giford Company, are the owners of all the productive wells in this group. Many prospect wells have been drilled around this small group of producers, but so

far the efforts to extend have resulted in failure. The list of these developments is as follows:

Union Oil Company of California—Robertson Tract. On this tract the Union Oil Company has fourteen wells, all but one of which are producers. No. 1 was drilled in 1896, and was abandoned when finished, though depth and reasons for abandoning are not known. No. 9 was drilled in 1897, and is 750 feet deep. No. 10, drilled in the same year, is 1240 feet deep. No. 12, drilled in 1898, is 1320 feet deep, No. 13 is 1565 feet deep, and No. 14, drilled in 1899, is 1040 feet deep. The production of these wells is not known, but is not large. The oil is of good quality.

Union Oil Company of California—Grimes Tract. On this tract, the east half of the east half of section 12, are nine wells, six of which are producers. No. 1, drilled in 1896, is a producer at 595 feet. No. 3, drilled in 1897, was abandoned when drilled. No. 5, drilled in 1898, is 1265 feet deep, and is not known to have ever produced. No. 7 was drilled in 1897, and was probably a failure, as there is no record of its having been on the pump. No. 9, drilled in 1898, is a producer at 1345 feet.

The earliest record of the production of the group of wells covering the Robertson and Grimes tracts, with one on the Burson, is for 1900, when twenty-four wells were reported to be making approximately 6000 barrels per month, or slightly over eight barrels per day per well. In 1911 this same group, consisting now of twenty producers, was said to be making in the neighborhood of 3000 barrels per month, or an average of five barrels per day per well. Considering the age of these wells, this slight rate of decrease is rather remarkable, even for Ventura County.

Union Oil Company of California—Santa Susana. In 1899 the Union Oil Company drilled on this lease, now operated by the Lapp-Gifford Company. This hole was dry at 1830 feet—it is not spotted on the map, as it can not be located, though shown on the records.

Union Oil Company of California—Bookhout. A well drilled by the Union on this tract, now operated by the Bardsdale Crude Oil Company in 1892. It was 1700 feet deep, and is recorded "not much oil"; at any rate, it never produced. Its location in relation to the present producing wells can not be learned.

John Irwin Oil Company. This corporation, a sub-company of the Union Oil Company of California, drilled on the Omega tract, the southwest quarter of the southeast quarter of section 1, 3–20. This well was 1100 feet deep, and was abandoned on account of water, without finding any oil.

Alger & Gilmore. A partnership under this name drilled on the

Balcom tract, in the flat, near the west line of section 9, 3–20, in 1903. This well was 1200 feet deep, and did not find any oil.

F. O. Wood is drilling in Sulphur Cañon, on the Miles Balcom farm, in the southeast quarter of section 10, 3–20. In March, 1912, this well was reported to be 2000 feet deep.

Santa Paula Home Oil Company. This company drilled two wells on property of E. C. Converse, Jr., in section 23, 3–21, in the year 1901. No. 1 was abandoned at 1000 feet, with no oil, but a large amount of water. No. 2 was stopped at about 600 feet for financial reasons.

Oak Ridge Oil Company. Has a hole of unknown depth in the northeast quarter of section 14, 3–21. In February, 1912, this rig had been suspended for some time.

Bardsdale Crude Oil Company. This company has eight shallow wells, all producers, on the Bookhout tract, southwest quarter of northwest quarter of section 12, 3–20. The records for these wells are as follows: No. 1, drilled in 1894, 580 feet. No. 2, drilled in 1900, 649 feet. No. 3, drilled in 1901, 550 feet. No. 4, same year, 425 feet. No. 5, same year, 450 feet. No. 6, same year, 660 feet. No. 7, same year, 630 feet. No. 8, drilled in 1909, depth 1550 feet. This well is a much larger producer than any of the foregoing, being rated at a twenty-barrel output.

Lapp-Gifford Company, Inc. This company has three producers and three drilling wells on the Santa Susana lease, the northeast quarter of the southwest quarter and the southeast quarter of the northwest quarter of section 12, 3–20. No. 1 was drilled in 1902 by the Peter Patterson Oil Company, and is 610 feet deep. No. 2 is 504 feet deep, and No. 3, 705 feet deep. Both the latter were drilled in the same year and by the same company.

Bell Oil Company. The Lapp–Gifford lease has now passed to the Bell Oil Company, which has drilled three wells and is now working on a fourth. Well No. 4 is a producer at 2200 feet. No. 5, at 1800 feet, and No. 6, at 500 feet. Well No. 7 was drilling at 900 feet at the end of March, 1912.

Peter Patterson Oil Company. Beside the three wells above mentioned, this company also drilled a hole in the Minnesota claim, the south half of the southeast quarter of section 11, 3–20. This hole was drilled in 1900, but the results are not reported.

West Huasna Oil Company. This company is reported to have leased the Omega claim, the southwest quarter of the southeast quarter of section 1, 3–20, and to be drilling, in June of the current year. This company had previously operated in the Huasna country in San Luis Obispo County, and in the western extension of the Santa Maria field.

In March, 1912, this hole was reported as a ten-barrel producer at about 1900 feet.

Montebello Oil Company. This company has a deep hole, reported to be 3100 feet deep, on the E. Burson tract, the west half of the southwest quarter of section 6, 3–19. This hole has made some oil of high gravity, but does not appear to have been a producer.

Hardly Able Oil Company. Immediately north of the foregoing, a well was drilled many years since. This hole is reported to have been dry at somewhere about 800 feet.

Union Oil Company of California—Burson. On the same tract, the Union Oil Company drilled two wells in 1898 and 1899. No. 1 is a small producer at 1230 feet. No. 2, just to the east, is 1399 feet; abandoned.

Merchants and Traders' Oil Company. On the same tract, but on the east line, and about three eighths of a mile north, an abandoned well. This well was drilled in 1903, and was a dry hole at some seven hundred feet.

Bardsdale Oil Company of Pomona. On the Lysle place, just to the northeast of the foregoing, this company drilled a hole in 1901. Depth something over seven hundred feet; never produced.

Capital Crude Oil Company. On the Climax claim, in the northeast corner of section 7. Depth not known, a small producer, now being pumped by the Union Oil Company in connection with the Grimes wells. An abandoned well a short distance to the east was probably drilled by the same parties, but no data is available.

Bardsdale Cañon Oil Company. Two wells on the Elkins tract, section 7. No. 1 is on the southwest quarter of the northwest quarter, was drilled in 1901, to 760 feet, and was abandoned on account of water without finding oil. No. 2 is on the northeast quarter of northwest quarter, was drilled in 1902, and was abandoned at 1000 feet with a trace of oil.

Grimes & Son. A hole on the north or east side of Grimes Cañon, on the northwest quarter of southwest quarter of section 7, is credited to Grimes & Son, and is said to be about 400 feet deep.

Central Union Oil Company. The well of this company is on the Shiells place, the north half of section 4, and is, therefore, to the east of the developments above mentioned. This well was drilled in 1901, and was a dry hole at 800 feet.

Montebello Oil Company. This company has lately developed some rather remarkable territory on the Shiells tract, section 4, 3–19. Here they have eight producing wells and one drilling (March, 1912), only a short distance south of the old Central Union hole. But little can be

learned as to the depths and productiveness of these wells. No. 5 is said to be 267 feet deep, and to be steadily producing 80 barrels per day—this well flowed when brought in. No. 15 is said to be but 160 feet deep, and to be good for 85 barrels per day. One of these wells, however (probably No. 6), is reported to be in the neighborhood of 1800 feet deep, and to produce even lighter oil than the shallower wells. The production from these wells approximates 28° gravity.

Calumet Oil Company. The well of this company, in the northeast quarter, southwest quarter section 3, 3–19, was 2250 feet, drilling in March, 1912. No oil yet reported.

Union Oil Company of California—Guiberson. This company drilled in 1901 on the Wanda Guiberson tract, on the east side of Guiberson Cañon, and just east of the west line of section 2, 3–19. This hole was spoiled at 1200 feet, and abandoned without finding oil.

Erie Oil Company. Just south of the foregoing, the Erie Oil Company, drilled in 1902. Depth reported at 1600 feet—no oil.

QUALITY OF THE BARDSDALE OILS.

The oils of this group show a strong resemblance to each other in appearance, being all of a black color, but not very opaque, are very thin and limpid, having a sweetish and rather mild odor.

On analysis, also, they show a strong resemblance, and evidently come from one set of sands, it being probable that the upper sand from which the Bardsdale Crude wells Nos. 1 to 7 produce is a stray, containing seepage from the lower sand. Eliminating these wells, all the samples show a striking uniformity of gravity, ranging only from 27.6° to 29.3° Beaumé.

The gasoline in all these oils runs high in quantity and also in starting point, this latter feature causing the yield of engine distillate to be small or absent. The wide boiling range of the gasoline thus cut somewhat depreciates it for the most particular trade, though it is still entirely marketable. The kerosene fraction is normal, as is the stove oil in all but one sample, that from Bardsdale Crude No. 8. This oil, run under strictly normal conditions, breaks down so greatly at the beginning of the lubricating cut as to give a very high yield of stove oil.

The lubricating stock from all these oils cracks very readily, and is in all cases solid with paraffin, and therefore of little value, as the paraffin does not crystallize, and so cannot be pressed out. The asphalt percentage is normal for oils of this gravity.

These oils are notably dissimilar to any other oils produced in Ventura county, being more like the crudes of Santa Maria, the latter showing the same high sulphur percentage, large gasoline and small engine-distillate yield, and the same tendency to paraffin in the lubricating stock.

While the yield of naphthas from these crudes is good, they are not well rounded refining oils, because of the failure of the heavy end of the oil.

5470.*

Bardsdale Crude Oil Co. Well No. 8.

Gravity ..... 27.7° Beaumé

This is a limpid, very black oil, with a mild and sweet odor. The well from which this sample was taken is considerably deeper than the other wells on this lease.

An average sample from the seven shallow wells was considerably more viscous, but had the characteristic color and odor. The gravity of this sample was 19.8° Beaumé.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	12.7 per cent	61.2° Beaumé
Second cut	7.0 per cent	50.5°
Third cut	8.0 per cent	42.0°
Fourth cut	41.3 per cent	32.9°
Fifth cut	25.4 per cent	21.4°
Fixed carbon	5.6 grams per 100 c.c.	
	100.0	

The lubricating stock from this distillation was too small in quantity to be re-run. After calculation of the asphalt, the following commercial analysis is shown:

Gasoline	61.1° Beaumé	13 per cent
Engine distillate	52.0°	5 per cent
Kerosene	42°	12 per cent
Stove oil	33°	39 per cent
Lubricating stock	21.4°	17 per cent
Asphalt	"D"	14 per cent or 47 lbs. per bbl.
		100 per cent

The yield of stove oil from this crude is most remarkable, and is evidently due to severe decomposition of the lubricating stock. This in spite of the fact that distilling conditions were quite normal.

The light products refine fairly well, to fair colors and very sweet odors. The asphalt is normal for an oil of this gravity. What remains of the lubricating stock is thick with amorphous paraffin, and apparently valueless.

*Analysis by J. P. P.

Union Oil Company of California. Robertson No. 2.

Gravity		27.6° Beaumé
Viscosity at 60° F.	7.43	Redwood (water—1)
Viscosity at 180° F.	1.51	Redwood (water—1)
Flash point	Below 60° F.,	Abel-Pensky test
Sulfur	1.74 per cent	by weight
Thermal value	18,871	British thermal units

Distillation.

A sample of 200 c.c., distilled from a glass still, without steam or gas.

Below 212° F.	8.9 per cent	68.9° Beaumé
212 to 302°	10.6 per cent	53.9°
302 to 392°	8.7 per cent	44.7°
392 to 482°	7.3 per cent	37.9°
482 to 572°	15.5 per cent	32.2°
572° to grade	29.0 per cent	29.5°
Asphalt	16.9 per cent	Grade "D" (about)
Loss	3.1 per cent	
	100.0	

This is closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	18 per cent
Engine distillate	52°	None
Kerosene	42°	17 per cent
Stove oil	33°	14 per cent
Fuel distillate and lubricants	29.50	19 per cent (not separated)
Asphalt	"D"	29 per cent or 102 lbs. per bbl.
Loss		3 per cent
		100 per cent

The hardness of the asphalt is not stated, and the quantity is so large for an oil of this gravity as to make it probable that it was softer than the standard. The lubricating stock in this distillation is evidently very badly cracked.

4480.*

Union Oil Company of California. Robertson, west end wells, mixture.

Gravity 29.5° Beaumé

This is a limpid oil, of a very black color, with a mild, sweet odor.

Distillation.

A sample of 150 c.c., was distilled from copper, without gas or steam. Run was interrupted at the end of the stove-oil cut, and asphalt not determined.

First cut	13.3 per cent	62.7° Beaumé
Second cut	7.3 per cent	52.3°
Third cut	10.4 per cent	41.9°
Fourth cut	15.7 per cent	32.4°
Residue, fuel oil	53.3 per cent	- - -
	100.0	

*Analysis by H. N. Cooper
*Analysis by J. P. P.

These figures give the following commercial analysis:

Gasoline	61° Beaumé	16 per cent
Engine distillate	52°	2 per cent
Kerosene	42°	15 per cent
Stove oil	33°	14 per cent
Fuel residue	---	53 per cent
		100

This crude gives a much smaller yield of stove oil than No. 5470, and does not break down so badly. Like most of the paraffin-carrying oils, however, the stove oil cut shows some signs of decomposition of the crude. The residue from this run contains much paraffin, and is of a butter-like consistency.

The gasoline starts very high, and gives 61° gasoline with a very wide distilling range, which is objectionable for particular work. The light oils treat out well.

2442.†

Union Oil Company of California. Grimes No. 1.

Gravity ---------- 28.0° Beaumé

This is a limpid, black oil, of a sweet odor. The viscosity at 60° F. is 13.6 by the Engler test.

Distillation.

A sample of 100 c.c., distilled from glass, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor — x 0.8) for oxidation during evaporation. The original figures are:

Below 212° F.	5.0 per cent	61.6° Beaumé
212 to 302° F.	7.9 per cent	
302 to 518° F.	20.5 per cent	43.4°
Residue above 518° F.	66.6 per cent	16.5°
	100.0 per cent	

The gravity of this residue is rather high, considering the temperature at which the crude was run, and indicated paraffin in the residue. After evaporation to asphalt, and calculation, the above figures are approximately equal to the following commercial analysis:

Gasoline	61° Beaumé	14.0 per cent
Engine distillate	52°	None
Kerosene	42°	21.0 per cent
Stove oil and lubricants	---	44.5 per cent (not separated)
Asphalt	"D"	20.5 per cent or 72 lbs. per bbl.
		100.0 per cent

†Analysis by E. N. Moor.

4476.*

Union Oil Company of California. Grimes, east end wells.

Gravity ..... 27.7° Beaumé

This is a limpid oil, of a blackish color, and a mild and sweet odor.

Distillation.

A sample of 150 c.c., was distilled from copper, first four cuts dry, last cut in a current of inert gas. Distilled to dryness.

First cut	13.4 per cent	63.6° Beaumé
Second cut	8.2 per cent	52.4°
Third cut	9.7 per cent	42.4°
Fourth cut	17.0 per cent	32.3°
Fifth cut	44.6 per cent	26.4°
Fixed carbon	7.1 grams per 100 c.c.	
	100.0	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of gas. The above figures give approximately the following commercial analysis:

Gasoline	61° Beaumé	17.5 per cent
Engine distillate	52°	None
Kerosene	42°	18.0 per cent
Stove oil	33°	13.2 per cent
Fuel distillate	30.5°	18.2 per cent) Slop distillate
Reduced stock	17.8°	15.5 per cent (26.4°—33.7 per cent
Asphalt	"D"	17.8 per cent or 62 lbs. per bbl.
		100.0

The light end of this oil refined only fairly well, giving, with the test acid, products of only fair color and odor, the latter in particular being rather sharp and penetrating. The yield of stove oil is low, and does not indicate the decomposition of lubricating stock noted in the oils from farther west in this group.

The lubricating stock is of only fair viscosity, but of good color, and gives a reduced stock of satisfactory color, and quite solid with paraffin at 60° F. This treats out to a red oil of deep red color and fair outer tone, with a cold test above 70° F., and therefore of little commercial value. Even the fuel distillate from this oil shows some paraffin.

The light end of this oil runs high in gasoline, and is therefore of value. The usefulness of the heavy end is very doubtful.

*Analysis by J. P. P.

4488.*

Union Oil Company of California. Grimes No. 9.

Gravity ---------- 28.3° Beaumé

This is a limpid oil, of a dead black color, and mild odor.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distilled to dry coke.

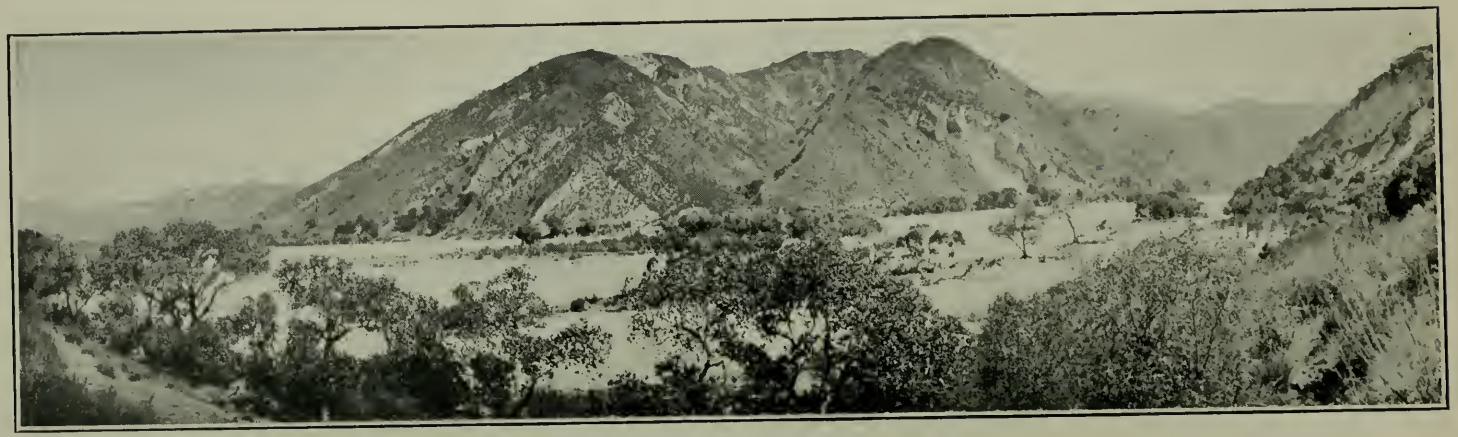
First cut	13.2 per cent	63.2° Beaumé
Second cut	5.8 per cent	52.2°
Third cut	15.6 per cent	42.6°
Fourth cut	13.6 per cent	33.4°
Fifth cut	46.7 per cent	23.6°
Fixed carbon	5.1 grams per 100 c.c.	
	100.0 per cent	

The last cut was reduced in a current of gas, and the carbon calculated to asphalt in the usual manner. This gives the following commercial analysis:

Gasoline	61° Beaumé	16.0 per cent	
Engine distillate	52°	None	
Kerosene	42°	21.0 per cent	
Stove oil	33°	10.0 per cent	
Fuel distillate	29.9°	21.8 per cent	Slop distillate
Reduced stock	Solid	18.5 per cent	23.6°—40.3 per cent
Asphalt	"D"	12.7 per cent	or 45 lbs. per bbl.
		100.0	

The light products from this crude treat well, to good colors, and sweet, very mild odors. The lubricating stock is strongly sulfurous, but gives a sweet reduced stock, of good color, but entirely solid with paraffin at normal temperatures. The red oil made from this stock by the standard acid treatment is pale red, with a good green outertone, and a gravity of 20.8°, the viscosity being rather low. This latter quality, however, cannot be observed at ordinary temperatures, as the oil has a cold test above 75° F., setting to a thick paste.

*Analysis by J. P. P.



Mouth of Temescal Creek, North of Piru, Ventura County.

CHAPTER VII.

MODELO, TORREY, EUREKA, AND TAPO WELLS.

Townships 4-18 and 3-18.

These townships contain four groups of producing wells, and a number of scattering prospect holes, some of which have been more or less productive. The producing groups are—the Modelo wells on sections 7 and 8, on the north side of the valley: the Eureka wells and the Tapo wells, in the north-dipping formation on the south side of the valley, and the Torrey wells, which are higher in the hills, and on the formation which dips beneath the Simi Valley. Many prospect wells have been drilled on Rancho Temescal; in the hills to the east: in the Nigger Cañon territory; to the west of the Eureka and Torrey wells; and on the Simi Rancho; but with the exception of three wells of late date on the latter, with little encouragement to the present time.

Modelo and Temescal Wells.

Piru Creek takes its rise in the high mountains to the north, and flows with a generally southern direction to the Santa Clara River. This stream is a winter torrent, almost disappearing in summer, and occupies approximately the center line, north and south, of the Temescal Rancho, which, indeed, covers but its valley and the low hills adjacent thereto. East and west of the ranch the hills are high and rough, brush covered, and comparatively waterless.

Modelo Oil Company. The wells of this company are located at the crest of an east and west anticline, dipping sharply in both directions, and plunging toward the east. The apex of this anticline appears to coincide with the upper portion of Modelo Cañon, but though this formation is plainly visible on the surface for some distance both east and west of this group of wells, it has not yet been shown that production extends any further in either direction than the present limits of this small group of wells. It should be said, however, that no consistent testing has ever been done in either direction.

The first wells of this company were drilled in 1898, and operations were carried on up to 1903, since which time no new work has been done. Wells Nos. 1 and 2 were producers at something over 600 and 800 feet, respectively. No. 3 was not drilled. Nos. 4 to 7 produced at 750 feet, 680 feet, 935 feet, and 980 feet, respectively, these six wells ranging from six to twelve barrels daily production. No. 8 is the well farthest to the east, and was abandoned on account of flowing water, but the depth is not known—this is unfortunate, as the location of this well is such as to have shown something as to an eastern extension, if the hole

was carried to a sufficient depth. No. 9 was also abandoned, reason not known. No. 10 was a producer at 1050 feet, No. 12 at 1103 feet, while Nos. 11 and 13 were not drilled. Nos. 14 and 15 are 860 feet each, and are producers, No. 16 is a producer at 800 feet, and No. 17 at 735 feet, these wells running about nine barrels each daily production. No. 18, drilled in 1901, was abandoned at 1100 feet—as this well is practically surrounded by producers, it is probably a spoiled hole. No. 19 was drilled in December, 1910, while Nos. 20, 23, 25, and 27 had not been drilled. No 21 is a producer at 1250 feet, and No. 22 at 1150 feet. No. 24 also produces at 1320 feet—these three wells range around nine barrels daily capacity each. No. 26, drilled in 1902, was abandoned at 1310 feet—this well is the farthest to the north, and, therefore, farthest down the north limb, and could hardly be considered a completed hole at this depth. No. 28 is a producer at 1250 feet, and No. 29 at 1420 feet, these wells being rated at twelve barrels per day each. As No. 29 is farthest to the northwest, and these two wells are probably the best producers on the lease, there are no indications of the producing limits of this group having been reached, at least to the west and south.

This group of wells is located on a high and steep hill, and operations are difficult for that reason. Indeed, the upper wells are not reached by road, but are served by a cable railway which raises material and supplies from the cañon to the more northerly wells. The formations penetrated are hard and stand up well, and, aside from the rather steep pitch of the formation, no great difficulties appear to be experienced in drilling.

Hutton & Company. The two wells shown on section 7, 4—18, in the southeast and southwest quarters, respectively, were hand-dug holes, put down about the time the first Modelo wells were drilled. These holes, where were but a few feet in depth, developed several gallons per day each of an oil generally resembling the Modelo oil, but considerably heavier. It has been thought that these holes locate the outcrop of the south limb of the Modelo anticline.

Slocum & Company. This company, which formerly operated the Slocum wells in Santa Paula Cañon, was drilling in the later months of 1910, in the southeast corner of section 8, 4–18, on what appears to be an extension of Modelo anticline. In February, 1912, this well was cementing at about 1100 feet, and was flowing water with a little oil. It is reported that this well found several thin layers of pay sand, containing an oil slightly heavier than the average Modelo oil, but that these sands were hard and close grained, and therefore of small productiveness.

Piru Oil & Land Company. This company, which owns the mineral rights to the entire Temescal Ranch, has drilled either five or seven wells, some of which obtained some oil, but none of which are at present producing. The little information which can be had as to these wells is as follows:

Wells Nos. 1 and 2 were drilled in 1900. No. 1 is located between the road and the creek, within the present bounds of the Piru Monarch lease. This well was drilled to a total depth of 1195 feet, and is said to have found producing sands at 432 feet, 840 feet, and 1035 feet. The water was not shut off, and the well is now flowing a little rather heavy oil, and when pumped is capable of doing perhaps two barrels per day.

Well No. 2 was located west of the Modelo Cañon road, in the southwest quarter of section 16. This well was a dry hole at 1220 feet.

Well No. 3 was in Blanchard Cañon, in the northwest quarter of section 9. This well was carried to a depth of 1680 feet, and had some oil and gas, but it is said that water broke in and could not be shut off.

Well No. 4 was near the center of the south line of the same section. This well was spoiled at a depth of 1420 feet, and found no oil.

Well No. 5 was in Modelo Cañon, in the northwest corner of section 16. This hole was dry at 1250 feet.

Two later wells are reported, but these can not now be located, and it is possible that the records have been confused. No. 6 is said to have been located on the hills south of Holser Cañon, to have been about 1000 feet deep, and to have found a little oil at some four or five hundred feet. No. 7 is said to have been drilled some twelve miles north of Piru, and probably near the north line of the ranch, in 1903. No information can be had.

Two or three wells are known to have been drilled on this ranch at a much earlier date, probably before 1885, but only the scantiest notices are now available.

United Oil & Mining Company. This company operated in 1909 and 1910 on a lease from Piru Oil and Land Company, in the southeastern corner of Temescal Rancho. Well No. 1 of this company was located near Piru No. 1, and was drilled to 700 feet. At about 400 feet a thin sand, of some two feet thickness, was found, and from this the well produced about two barrels per day of an oil of 20° gravity.

No. 2 was near the southeast corner of section 16, and was carried to a depth of something like 1500 feet. At slight depth a thin sand, producing medium-grade oil, was found, and near the bottom of the hole several streaks producing gas and a little oil, said to be 38° gravity. These sands, however, were thin and very hard, and the well was never brought to production. The property was abandoned in the current year, when No. 3 had reached but a slight depth.

Piru Monarch Oil Company. In 1911 the above property passed to the Piru Monarch Oil Company, who continued well No. 2 (now Piru Monarch No. 1) to a depth of 1740 feet. This well now makes 2½ barrels of 37° oil daily, the oil being of a very peculiar quality.

Well No. 3 (now Piru Monarch No. 2) is now drilling at 1170 feet, with the water shut off. The hole is full of water, but is showing considerable gas and some oil.

Berkeley Oil Company. On the south side of Leckler Cañon, near the east line of section 1, 4–18. This well was drilled in 1901, and abandoned at 750 feet, with two strings of tools in the hole and no indications of oil.

Crown King Oil Company. This company was drilling in September, 1910, on the north side of Holser Cañon, in section 12, 4–18.

Ramona Home Oil Company. This company was also drilling in a branch cañon south of Holser Cañon, near the east line of section 13, in the same month. In February, 1912, this well was 1300 feet deep, and was having some trouble with crooked hole.

Ramona Oil Company. This well was drilled in 1901, in the west half of west half of section 13. It was something over 900 feet deep; no results were reported.

Nuevo Camulos Oil Company. This well is located near the west line of the southeast quarter of section 14, 4–18, and was drilled in 1900. At 880 feet this hole is said to have been entirely barren.

These three holes are all near the apex of the first ridge north of Santa Clara Valley, and were reached from the north because of the steep pitch of this face of the ridge. They appear to be on formation with a south dip, which shows some seepages further to the south—on fractional sections 23 and 24. It is more than possible that all three of these wells were back (north) of at least such sands as outcrop.

Santa Ana Oil Company. This company, which also drilled in the San Joaquin Hills, near Newport, and in the Elsmere division of the Newhall field, has an abandoned hole in the southeast quarter of section 18, 4–18. This well was drilled in 1900, and is said to have been a dry hole at 600 feet.

Nettleton & Kellerman Oil Company. This company, who also operated at Newhall, drilled three wells just east of the foregoing. These wells were put down in 1900 and 1901.

No. 1 would have made a small producer at some 300 feet, perhaps two or three barrels per day, of a heavy black oil of some 14° Beaumé. It was carried to a total depth of 1640 feet, but found no oil below this shallow sand, and finally went into salt water.

No. 2 was located some 300 feet in a generally northerly direction from No. 1, and was a dry hole at about 800 feet.

Vertical Strata at Base of Torrey Formation, Eureka Cañon. Ventura County.

Contorted Strata, Eureka Cañon, Ventura County.

No. 3 was located some 300 feet southeast of No. 1. This well found what appeared to be the same sand met in No. 1, but at a depth of 500 feet, and was then carried to 800 feet without finding any further oil.

During 1910 these wells were rigged for pumping, to furnish fuel for rigs in the neighborhood, and are said to have developed about one half barrel per day each, steady production.

Colonia Oil Company of Oxnard, Cal. In November, 1900, this company was drilling not far south of the Nettleton & Kellerman wells, and had then reached a depth of 1300 feet.

Ventura Oil Development Company. At the same time this company was drilling two wells, No. 1 west of the Nettleton & Kellerman wells, and No. 2 about one half mile to the northwest, and far up the hill. At that time they had reached depths of 700 feet and 1000 feet, respectively, and were not operating. In February, 1912, No. 1 had been carried to 1500 feet without a discovery, and both wells were shut down.

Eureka Wells.

South Pacific Oil Company. These wells are located about one half mile above the mouth of Eureka Cañon, and are on north-dipping formation, or possibly immediately in the zone of crushing. This view, which is based on the close proximity to the outcrops of strata dipping to the south, and parallel to those in which the Torrey wells are drilled, is borne out by the great irregularity in depth, and the scattering nature of the production.

The earlier wells were drilled by the Eureka Oil Company, the first work having been done in about 1893. No work has now been done for many years, and, as little pains have been taken to keep these wells in condition, they make considerable water, which, however, settles freely. The records are very scattering, but are here given, so far as they can be had.

The first six wells are all producers, the depths (at present) being: No. 1, 180 feet; No. 2, 725 feet; No. 3, 600 feet; No. 4, 250 feet; No. 5, 300 feet; No. 6, 380 feet. No. 7 was abandoned at 280 feet on account of sand and water; No. 8 for reasons not known at 470 feet; No. 9 at 600 feet; No. 10 at 650 feet. No. 11 was a spoiled hole at 650 feet. No. 12 is a producer at 400 feet, and No. 13 at 375 feet. No. 14 is abandoned, depth not known. No. 15 is a producer at 300 feet, and No. 16 was abandoned at 700 feet on account of water. No. 17 is also an abandoned hole; while Nos. 18 and 19 are producers, depths not known. No. 20 was abandoned on account of lost tools; No. 21 is said to have been deeper than the other wells and to have had no oil, and No. 22 was also a dry hole, though depth of none of these is recorded.

The three wells to the south, Nos. 18, 19, and 22, are plainly in the Torrey formation, and would indicate that a strip along the south side of this tract would be productive. The total daily production of this lease is said to approximate fifty barrels, which is probably much less than its possible capacity, if the wells now drilled could be put in proper working condition. The formation encountered in drilling these wells is said to have been much less regular than is usually the case in this vicinity, and much water was found.

Ventura Coast Oil Company. This company operated in 1910 in a branch cañon south of the river, and not far from the Eureka wells. This hole is said to have been 650 feet deep, and had had some oil, though it was abandoned because of water.

McCray Bros. Oil Company. This company is said to have drilled in the first cañon east of Torrey Cañon, and just in the edge of the hills, some years since. This well is reported to have been a dry hole at about 1200 feet. It was located well out on the north dip.

This company also drilled three wells on the south dip, west of the Torrey Cañon wells, on fractional section 5. No record can be found of the first hole; No. 2 is said to have been 1200 feet deep, and No. 3 about 1600 feet, and both entirely barren. This work was done in 1900.

Tapo Cañon Wells.

Tapo Cañon wells—Union Oil Company—Thos. R. Bard—Warring Bros.—F. E. Good. Only very scattering information can be had as to the group of old wells in the flat near the mouth of Tapo Cañon. The first well at this location seems to have been drilled by Thos. R. Bard in 1882. Mr. Bard is said to have maintained a small refinery at this point, where asphalt and other products were made from the output of this well. This well is said to have been a little over 300 feet deep, and has been long abandoned.

During the next ten years the property passed through several hands. First, Warring Brothers drilled three wells, later three more were drilled by Hardison & Stewart. In 1893 the property was absorbed by the Union Oil Company, who drilled four wells. Nothing is known as to the depths or the productions of any of these wells, except in a very general way, but they were quite shallow, and made but a small amount of oil.

Shortly after this the lease was taken over by Mr. F. E. Good, who drilled seven wells, six of which are now producing. These wells were deeper, averaging about 1050 feet. It is reported that when the property was taken over by Good, the eleven wells existent at that time did not produce enough oil to run a drilling rig. The lease and all the wells were afterward sold back to the Union, and in 1900 the six wells

then pumping were reported to be making about 300 barrels per month in all. The present output from these old wells is very small.

In 1910 the drilling rights on this property were transferred to the Camulos Oil and Development Company, the surface being retained by the Newhall Land and Farming Company, and the pumping rights on the old wells by the Union Oil Company. The Camulos company drilled a shallow well, and at the same time subleased a portion of the tract to the Canadian Queen Oil Company and to C. F. Grundy, both of whom drilled. The well of the Great West Oil Company, now drilling, is on a sublease of a portion of the same tract.

The formation on which the old wells are located seems to dip to the north and a little west, and the shallowest wells are therefore those to the southeast. The depths of the string from No. 12 to No. 16 are said to show a consistent dip to the northwest, but it is not entirely certain whether these wells are actually on the north dip, or on broken ground.

The Canadian Queen well went far deeper than the deepest of the old wells, and evidently drew its oil from lower sands. It was expected that the Grundy well would show these sands, but at a depth of 1900 feet this hole was practically barren.

Canadian Queen Oil Company. On the Tapo Rancho, northeast and a short distance from Union No. 16, is the well of the Canadian Queen Oil Company of Los Angeles. This well was drilled in 1910 to a depth slightly in excess of 2000 feet. A considerable yield of a light black oil, quite different from that of the old wells, was had near the bottom of the hole, but an excessive amount of water, which could not be shut off, made the operation of the well quite difficult. It was not being pumped at last report, though it had made at times as high as one hundred barrels per day, a very unusual production for the territory.

Camulos Oil and Development Company. In November, 1910, this company was drilling at 160 feet near the Canadian Queen well.

Grundy Oil Company (not incorporated). A hole drilled by Mr. C. F. Grundy of Los Angeles, in the southeast quarter of section 36, 4–18, is usually credited to the Grundy Oil Company or the Pacific Automobile Company. This well was drilled in 1911, was 1900 feet deep, and found no oil. It is abandoned.

Great West Oil Company. South of the old Tapo wells, and in the southwest quarter of the section, the Great West Oil Company is drilling. In February, 1912, this well is reported to be 1050 feet deep, and to have found some very light oil.

McGuire Tract. No information can be had as to the two wells on the McGuire tract in section 1, 3–18. They are believed to be shallow, dry holes.

Torrey Cañon Wells.

Union Oil Company of California—Torrey. On this tract there are fifty-six wells, all but three or four of which are believed to be producers. The opinion of parties who were originally concerned in the development of this tract is that the limit has been reached on the north, and possibly on the west, but not to the south and east. These wells are entirely located on the south dip, and depths increase with some rapidity in that direction, up to a maximum of some 2000 feet.

The only record available as to these wells is of the work done in the years 1898 and 1899. This, however, while it covers only a portion of the work, probably gives a fair idea of the depths to which the holes in this group are carried.

No. 1—drilled in 1896 to 500 feet; deepened in 1899 to 1010 feet.
No. 5—deepened in 1898 to 1855 feet, but plugged at 1620 feet.
No. 6—deepened in 1898 to 1070 feet.
No. 7—depth 1600 feet.
No. 8—deepened in 1899 from 670 feet to 1250 feet, later to 1750 feet.
No. 9—depth 1400 feet.
No. 10—depth 1600 feet.
No. 11—depth 1600 feet.
No. 12—depth 1300 feet.
No. 13—deepened in 1898 to 1325 feet.
No. 17—depth 1750 feet.
No. 22—depth 1110 feet.
No. 23—depth 724 feet.
No. 24—depth 940 feet.
No. 25—depth 1260 feet, deepened to 1750 feet.
No. 26—depth 1140 feet.
No. 27—depth 1455 feet.
No. 28—depth 1352 feet.
No. 29—depth 1550 feet.
No. 30—depth 1570 feet.
No. 32—depth 1965 feet.
No. 33—depth 1890 feet.
No. 34—depth 1450 feet, later deepened to 1850 feet.
No. 35—depth 1145 feet.
No. 36—depth 1400 feet.
No. 39—depth 1400 feet.
No. 43—depth 2000 feet.
No. 47—depth 2000 feet.
No. 49—depth 2000 feet, dry hole.
No. 50—depth 2000 feet, water only.
No. 56—depth 2500 feet, water and oil, not produced.

Looking up Eureka Cañon Toward Tapo Wells.

Torrey Cañon, Ventura County.

No. 52, 1410 feet, was drilled in 1900.

In October, 1899, all the wells from No. 1 to No. 35 were on the pump, except Nos. 9, 11, and 16.

Tapo Oil Company. On the Tapo Rancho, in section 14, 3–18, the Tapo Oil Company is reported to have drilled three wells in 1900 and 1901. But one of these, No. 3, can now be located. This is said to have been a dry hole at 700 feet, and it is probable that the other two were also shallow.

Simi Wells.

Scarab Oil Company. This company had two wells on the northeast corner of 32, 3–18. No. 1 was drilled in 1910, to a depth somewhat exceeding 2700 feet, and was first reported as a very large producer, having layers of rather loose producing sand alternating with shale for the last four hundred feet or more. After pumping for some months, however, this well dwindled considerably, and is now good for probably fifty barrels of oil per day. It is said to be making a great deal of water, which may account for the diminished production. No. 2 on this lease was not completed at last reports.

Union Oil Company of California—Dickerson. Near the southwest corner of the northwest quarter of section 33, the Union Oil Company finished a producer in 1910. This well is about 1000 feet deep, but produces its oil from a depth of about 700 feet, and is reported to be good for sixty barrels steady production.

No analyses of either of these oils is available, but the oil is undoubtedly heavier than the light oils characteristic of the hard formations to the north. The Union oil is reported at 16° to 17° Beaumé, the Scarab production at about 20°.

Township 3-17.

No production is found in this township, west of the line between Ventura and Los Angeles counties. The Pico Cañon wells, which are located in section 1, are on the Los Angeles side, and will be considered in connection with Newhall. There are, however, eight prospect holes, and one well was drilling when last visited.

Union Oil Company of California—Fryer. The Union Oil Company were rigged and just starting to drill in the latter months of 1910, in the Herbert Fryer tract, in the southeast quarter of section 8.

McCray Bros. Oil Company. This company drilled two wells just south of the above location, several years since. One of these was a dry hole, the other obtained a very little quite heavy oil at a depth of about 700 feet. This latter well is still cased, and is said to be pumped for local fuel purposes from time to time. These wells were drilled on a brea bed, and apparently immediately on the outcrop of the Torrey sands.

Simi Oil Company. In the southeast quarter of section 30, in the hills west of Las Llajas Cañon, are five wells drilled by the Simi Oil Company in the years 1900 to 1902. The record of these wells is as follows:

No. 1 was drilled to 1242 feet, No. 2 to about 1125 feet, No. 3 to about 1400 feet, No. 4 to 1275 feet, and No. 5 to 1725 feet. All these were finished wells, and each had some oil, which is said to have been about 32° Beaumé. These wells seem to have made just enough oil to encourage further operations, and the entire output of the five was not sufficient to justify operation of the lease, though the wells have since been pumped from time to time for fuel. The oil seems to have been of excellent quality.

Pittsburg Petroleum Company. In 1910 the Simi Oil Company tract was leased to the Pittsburg Petroleum Company, who drilled a well about 450 feet deep, abandoning with crooked hole and a string of tools lost.

Ventura Consolidated Oil Company. In 1911 this tract again changed hands, the lease passing to the Ventura Consolidated Oil Company. This company moved the Pittsburg rig a short distance, and drilled another hole, which is now suspended at about the same depth, 450 feet.

QUALITY OF THE OILS OF PIRU CAÑON, TORREY AND TAPO.

But a portion of the various qualities of oil found on the Rancho Temescal and in its vicinity are represented in the following analyses, though these cover all the grades commercially produced.

In Nigger Cañon, west of the ranch, the Nettleton & Kellerman wells make a small amount of a very heavy black oil, said to be about 14° Beaumé. Some of the old Piru Oil & Land Company wells found an oil ranging from 18° to 20° Beaumé. The last well of the Piru Monarch Oil Company is reported to have found a small production of an oil of 37° Beaumé, very gassy and quite limpid when taken from the well, but solidifying at about 60° F. to a pasty solid and evidently containing a great deal of paraffin.

The Modelo wells all produce one grade of oil, varying only from 26.5° to 28.0° Beaumé in gravity, and all showing about the same analysis. This oil is black with a very slight greenish cast, is not so opaque as many of the black oils, and gives a uniformly high yield of gasoline and other light products, and very little asphalt. The heavy end of the crude contains less paraffin than some of the light oils from the east end, but is too tender to be of much value.

The Torrey wells show a wider range of gravity, running down to 24° and up to 30° Beaumé. These oils are brownish-black in color, give

a good yield of light products, and rather more asphalt than the Modelo oils. The heavy end of these crudes has much paraffin.

The oil from the Eureka wells (South Pacific Oil Company), shows a wider range of gravity, though the bulk of the output is around 26° Beaumé. These oils tend to a greenish cast, and like all the Ventura oils of this color, run very low in light products for the gravity, and also low in asphalt. The heavy end of the crude appears to be free from paraffin. The commercial difference between these oils and the Modelo or Torrey oils is quite marked, as a comparison of the analyses will show.

This distinction between the true black or brownish-black oils and the greenish oils is very marked in the case of the two qualities from the Tapo wells. Attention is called to this difference in connection with analysis No. 5480. A comparison of these two analyses will be interesting.

2429.*

Modelo Oil Company. Tank Average.

Gravity ---------- 26.6° Beaumé

This is a limpid, brownish-black oil, of a sweet and gassy odor.

Distillation.

A sample of 100 c.c., distilled from glass, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and weight corrected (factor x 0.8) for oxidation during evaporation. The original figures are:

Below 212° F.	0.6 per cent	
212 to 302°	13.6 per cent	59.4° Beaumé
302 to 518°	32.4 per cent	40.8°
Residue above 518°	53.8 per cent	12.4°
	100.0 per cent	

After evaporation of the residue to asphalt, and calculation, the figures above are approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	11 per cent
Engine distillate	52°	None
Kerosene	42°	35 per cent
Fuel distillate and lubricants		41.8 per cent (not separated)
Asphalt	"D"	12.2 per cent or 42.8 lbs. per bbl.
		100.0 per cent

*Analysis by E. N. Moor.

4473.*

Modelo Oil Company. Well No. 28.

Gravity ---------- 28.0° Beaumé

This is a very limpid, black oil, with a greenish tinge, and mild, gassy odor.

Distillation.

A sample of 150 c.c. was distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to a residue of dry coke.

First cut	10.9 per cent	62.3° Beaumé
Second cut	8.6 per cent	52.1°
Third cut	17.5 per cent	42.0°
Fourth cut	10.1 per cent	33.0°
Fifth cut	50.6 per cent	22.5°
Fixed carbon	2.3 grams per 100 c.c.	
	100.0 per cent	

On calculation of the coke to asphalt in the usual manner, and reduction of the last cut in a current of gas, these figures show the following commercial analysis:

Gasoline	61.0° Beaumé	13.0 per cent	
Engine distillate	52.0°	5.0 per cent	
Kerosene	42.0°	20.0 per cent	
Stove oil	33.0°	9.0 per cent	
Fuel distillate	28.3°	17.0 per cent	Slop distillate
Reduced stock	15.0°	30.2 per cent	22.5°—47.2%
Asphalt	"D"	5.8 per cent	or 20.4 lbs. per bbl.
		100.0 per cent	

The light products from this crude treat out very readily, and give oil of good color and odor. The lubricating stock has a low viscosity, but is sweet, and gives a reduced stock of fair viscosity and good color. This treats out to a red oil of 17.3°, of normal viscosity and a fair color. Paraffin is less in evidence than in most of the oils from this end of the field, but the value of the crude is largely in the light end.

7422.†

Modelo Oil Company. Well No. 22.

Gravity ---------- 28.4° Beaumé

Viscosity at 60° F. ---------- 2.28 Redwood

Viscosity at 185° F. ---------- 1.23 Redwood

Flash point ---------- Below 60° F., Abel–Pensky test

Distillation.

200 c.c., distilled from glass still, without steam or gas.

Below 212° F.	7.7 per cent	66.6° Beaumé
212 to 302°	15.6 per cent	51.3°
302 to 392°	10.7 per cent	42.3°
392 to 482°	10.8 per cent	34.8°
482 to 572°	14.0 per cent	28.6°
572° to grade—a	15.3 per cent	24.4°
572° to grade—b	8.9 per cent	32.0°
Asphalt	16.6 per cent	Grade "D" (about)
Loss	0.4 per cent	
	100.0 per cent	

*Analysis by J. P. P.

†Analysis by H. N. Cooper.

These figures are closely equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	15.0 per cent
Engine distillate	52.0°	None
Kerosene	42.0°	26.0 per cent
Stove oil	33.0°	4.0 per cent
Fuel distillate and lubricants	27.7°	38.0 per cent (not separated)
Asphalt	"D"	16.6 per cent
Loss		0.4 per cent
		100.0 per cent

The hardness of the asphalt is not stated and the figure appears to be a shade high for "D" grade. The first part of the lubricating stock came over in good shape, considering the method of distillation, but the last end broke very badly.

2474.*

Union Oil Company. Torrey No. 4.

Gravity ..... 23.9° Beaumé

This was said, when the sample was taken in 1903, to be the heaviest oil on the lease. It is a limpid, blackish oil, of a sweet and gassy odor.

Distillation.

Sample of 100 c.c., distilled from glass, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor x 0.8) for oxidation during evaporation. The original figures are:

Below 212° F.	1.1 per cent	
212 to 302°	6.1 per cent	54.0° Beaumé
302 to 518°	26.7 per cent	38.0°
Residue above 518°	66.4 per cent	16.4°
Loss	1.7 per cent	
	100.0 per cent	

The gravity of this residue was rather high, considering the temperature at which the run was ended, and indicates paraffin in the residue. After evaporation to asphalt, and calculation, these figures are roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	1.0 per cent
Engine distillate	52°	6.0 per cent
Kerosene	42°	20.0 per cent
Stove oil and lubricants	33°	53.0 per cent (not separated)
Asphalt	"D"	20.0 per cent or 70.2 lbs. per bbl.
		100.0 per cent

*Analysis by E. N. Moor.

2476.*

Union Oil Company. Torrey No. 28.

Gravity ..... 28.1° Beaumé

This is a very limpid black oil, of a sweet and gassy odor.

Distillation.

A sample of 100 c.c., distilled from glass, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are:

Below 212° F.	2.2 per cent	
212 to 302°	14.4 per cent	53.7° Beaumé
302 to 518°	23.6 per cent	39.8°
Residue above 518°	56.7 per cent	16.4°
Loss	3.0 per cent	
	100.0 per cent	

After evaporation of the residue to asphalt, and calculation, the above figures are approximately equal to the following commercial analysis:

Gasoline	61° Beaumé	2.5 per cent
Engine distillate	52°	14.0 per cent
Kerosene	42°	21.0 per cent
Stove oil	33°	25.0 per cent
Stove distillate and lubricants		20.0 per cent (not separated)
Asphalt	"D"	17.5 per cent or 61.4 lbs. per bbl.
		100.0 per cent

7421.†

Union Oil Company. Torrey No. 52.

Gravity ..... 29.9° Beaumé
Viscosity at 60° F. ..... 3.73 Redwood
Viscosity at 185° F. ..... 1.38 Redwood
Flash point ..... Below 60° F., Abel–Pensky test
Sulfur ..... 0.71 per cent by weight
Thermal value ..... 19,100 British thermal units

Distillation.

200 c.c., distilled from a glass still, without steam or gas.

Below 212° F.	8.3 per cent	68.7° Beaumé
212 to 302°	10.4 per cent	52.4°
302 to 392°	9.1 per cent	44.3°
392 to 482°	8.8 per cent	38.3°
482 to 572°	10.2 per cent	32.6°
572° to grade—a	23.9 per cent	30.2°
572° to grade—b	9.8 per cent	31.4°
Asphalt	16.6 per cent	Grade "D" (about)
Loss	2.9 per cent	
	100.0 per cent	

*Analysis by E. N. Moor.
†Analysis by H. N. Cooper.

These figures are closely equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	17.0 per cent
Engine distillate	52.0°	None
Kerosene	42.0°	14.8 per cent
Stove oil	33.0°	14.6 per cent
Fuel distillate and lubricants	30.5°	51.1 per cent (not separated)
Asphalt	"D"	16.6 per cent
Loss		2.9 per cent
		100.0 per cent

The entire lack of engine distillate is due to the high gravity at which the gasoline starts, causing this fraction to overrun what would otherwise be the 52° cut. This fraction could, of course, be made by different cutting.

5411.*

South Pacific Oil Company. Eureka No. 18.

Gravity ---------- 19.8° Beaumé

This is a brownish-black and fairly limpid oil, with an unusually flat and rather sour odor.

Distillation.

A sample of 150 c.c. was distilled from copper, first two cuts dry, last cut in a current of inert gas. Distillation carried to dry coke.

First cut	17.7 per cent	42.0° Beaumé
Second cut	20.0 per cent	32.9°
Third cut	54.0 per cent	23.9°
Fixed carbon	5.7 grams per 100 c.c.	
	100.0 per cent	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of gas. The above figures are then equivalent to the following commercial analysis:

Gasoline	61.0° Beaumé	None
Engine distillate	52.0°	None
Kerosene	42.0°	17.7 per cent
Stove oil	33.0°	20.0 per cent
Fuel distillate	29.8°	21.8 per cent (Slop distillate
Reduced stock	17.5°	23.7 per cent (23.9°—45.5%
Asphalt	"D"	14.2 per cent or 50.0 lbs. per bbl.
		100.0 per cent

The kerosene did not take the acid well, giving a yellowish oil, though of sweet odor. The lubricating stock was badly burned, of a black color and low viscosity. On reduction this gave a medium viscosity reduced stock, which treated out to a low viscosity red oil of fine color. This well had not pumped for some time, but was flowing slowly, and it is

*Analysis by P. W. P.

possible that the oil is somewhat debased. The heavy end of the oil seems to be tender, but is free from paraffin.

4489.*

South Pacific Oil Company. Eureka Wells, northeast end of lease.

Gravity ..... 25.6° Beaumé

This is a very limpid, brownish-black oil, with a sweet and rather gassy odor.

Distillation.

A sample of 140 c.c. was distilled from copper, first three cuts dry, last cut in a current of gas. Distilled to dryness.

First cut	5.8 per cent	52.4° Beaumé
Second cut	17.2 per cent	42.7°
Third cut	14.2 per cent	33.8°
Fourth cut	57.7 per cent	23.9°
Fixed carbon	5.1 grams per 100 c.c.	
	100.0 per cent	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of gas. This gives the following commercial analysis:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	6.0 per cent	
Kerosene	42.0°	18.0 per cent	
Stove oil	33.0°	13.0 per cent	
Fuel distillate	31.0°	20.6 per cent	Slop distillate
Reduced stock	17.7°	29.6 per cent	23.9°—50.2%
Asphalt	"D"	12.8 per cent	or 44.9 lbs. per bbl.
		100.0 per cent	

The light products from this crude were rather dark, but treated out to good colors and odors. The lubricating stock also ran dark, with a strong odor, but gave a reduced stock of normal characteristics. This, with the test acid, gave a red oil of 20.2° Beaumé, rather dark, but with a fine green over tone, and a high viscosity, cold test about 50° F. This stock contains less paraffin than most of the oils from this end of the county, and in spite of an abnormally low yield of light products for an oil of this gravity, refines very well.

*Analysis by J. P. P.

5412.*

South Pacific Oil Company. Eureka Wells. (Mixture of three.)

Gravity ---------- 26.2° Beaumé

This is a very limpid, brownish-black oil, with a gassy and rather sharp odor.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation carried to a residue of dry coke.

First cut	6.5 per cent	57.1° Beaumé
Second cut	6.9 per cent	50.5°
Third cut	10.3 per cent	41.8°
Fourth cut	24.0 per cent	33.0°
Fifth cut	46.8 per cent	21.1°
Fixed carbon	5.5 grams per 100 c.c.	

100.0 per cent

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of inert gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	2.5 per cent
Engine distillate	52.0°	10.9 per cent
Kerosene	42.0°	10.0 per cent
Stove oil	33.0°	24.0 per cent
Fuel distillate and lubricants	21.1°	38.8 per cent (not separated)
Asphalt	"D"	13.8 per cent or 48.4 lbs. per bbl.

100.0 per cent

The light products from this oil took the acid only fairly well, coming out with sweet odors, but in fair colors only. The lubricating stock was not fractionated. It appeared to be free from paraffin, but rather light and somewhat burned.

2477.*

South Pacific Oil Company. Lease Average.

Gravity ---------- 27.4° Beaumé

This is a limpid, brownish oil, of a sweet and gassy odor.

Distillation.

Sample of 100 c.c., distilled from glass, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor x 0.8) for oxidation during evaporation. The original figures are:

Below 212° F.	5.0 per cent	
212 to 302°	14.4 per cent	59.2° Beaumé
302 to 518°	26.1 per cent	40.1°
Residue above 518°	54.0 per cent	12.1°
Loss	0.5 per cent	

100.0 per cent

*Analysis by P. W. P.

*Analysis by E. N. Moor.

After evaporation to asphalt, and calculation, these figures are approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	6.0 per cent
Engine distillate	52°	13.5 per cent
Kerosene	42°	24.0 per cent
Stove oil	33°	23.0 per cent
Fuel distillate and lubricants		23.1 per cent (not separated)
Asphalt	"D"	18.4 per cent or 64.6 lbs. per bbl.
		100.0 per cent

4481.*

Union Oil Company. Tapo, average six wells.

Gravity ..... 21.8° Beaumé

This is a limpid oil of a very black color, with a penetrating and gassy smell.

Distillation.

A sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	5.7 per cent	59.3° Beaumé
Second cut	6.1 per cent	51.5°
Third cut	11.4 per cent	42.4°
Fourth cut	13.7 per cent	32.9°
Fifth cut	54.0 per cent	24.1°
Fixed carbon	9.1 grams per 100 c.c.	
	100.0 per cent	

The carbon was calculated to "D" asphalt in the usual manner, and the last cut reduced in a stream of gas, giving the following commercial analysis:

Gasoline	61.0° Beaumé	3.5 per cent	
Engine distillate	52.0°	9.5 per cent	
Kerosene	42.0°	10.0 per cent	
Stove oil	33.0°	13.7 per cent	
Fuel distillate	29.7°	23.5 per cent	Slop distillate
Reduced stock	14.5°	17.0 per cent	24.1°—40.5%
Asphalt	"D"	22.8 per cent or 80 lbs. per bbl.	
		100.0 per cent	

The light products from this oil run very high for an oil of this gravity, and treat out readily. The heavy end of the oil is of little value, because of an excess of paraffin.

*Analysis by J. P. P.

5480.*

Canadian Queen Oil Company. Tapo No. 1.

Gravity ..... 21.8° Beaumé

This is a moderately limpid oil, of a greenish-black color, and much less opaque than No. 4481. The odor is flat and unpleasant.

This well was drilled in the midst of the group of wells from which No. 4481 was taken, but draws its oil from a deeper sand. The contrast between these two analyses, of oil of exactly the same gravity, is very striking, as these two samples represent almost the extremes of quality.

Distillation.

A sample of 150 c.c. was distilled from copper, in a stream of inert gas, distillation being carried to dry coke.

First cut	9.7 per cent	33.0° Beaumé
Second cut	83.4 per cent	21.8°
Fixed carbon	6.9 grams per 100 c.c.	

100.0 per cent

On reduction of the second cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is had:

Gasoline	61.0° Beaumé	None	
Engine distillate	52.0°	None	
Kerosene	42.0°	None	
Stove oil	33.0°	9.7 per cent	
Fuel distillate	30.1°	26.3 per cent	Slop distillate
Reduced stock	16.2°	46.7 per cent	21.8°—73.0%
Asphalt	"D"	17.3 per cent or 70.7 lbs. per bbl.	

100.0 per cent

The stove oil had an amber color and a very rank odor, neither of which were much improved by treatment. The lubricating stock was mild, and of medium viscosity, and gave a reduced stock of moderate viscosity and dull color, tending to brownish. This oil is a satisfactory lubricating stock, showing no paraffin, and would handle fairly well in large scale distillation and treatment. The entire absence of light products is surprising, as the crude had not been weathered. This oil is very similar to some of the greenish oils of the Ex-Mission.

*Analysis by P. W. P.

CHAPTER VIII.

CALLEGUAS WELLS.

Township 2-20.

But one group of wells is found in this township, and no prospecting outside of this group has ever been done. This group is located on Rancho Calleguas, in section 28, some two and one half miles south of the town of Camarillo.

Union Oil Company of California—Calleguas—Dolton & Perkins. The original wells in this location, thirty-four in all, were drilled by the Union Oil Company in the years 1898 and 1899. They were put down with a star rig, in the immediate vicinity of a seepage, and with two exceptions were very shallow.

No. 1, a test well located near the center of the group, encountered the sand at 60 feet and passed out of it at 80 feet. At 120 feet water was found—this was cased off, and the well carried to 1300 feet without finding either water or oil.

No. 2 was 583 feet deep—its history is not known.

Nos. 3 to 20, inclusive, were drilled in the year ending October 1. 1898. The aggregate depth of these wells was 2457 feet, or an average of 137 feet per well.

Nos. 21 to 34, inclusive, were drilled in the year ending October 1, 1899. The aggregate depth of these fourteen wells was 2275 feet, or an average of 163 feet per well.

In spite of the slight depth of these holes, and the thin layer of sand from which they produced, these holes were rated as good producers for a time, and a pipe line was laid to the railroad. A short period, however, saw them practically exhausted, and the lease was stripped and abandoned in June, 1899.

In the latter part of 1910, this lease was again worked by Dolton & Perkins of Santa Barbara, a partnership, who cleaned out a number of the old holes, and at last reports had drilled six new shallow ones, and had twenty-seven in all on the pump. At that time the entire group was considered to be good for a daily production somewhat in excess of twenty barrels.

CHAPTER IX.

SUMMARY OF OPERATIONS IN VENTURA COUNTY.

This completes the list of operations in Ventura County, so far as the records of the Mining Bureau extend, and, with the possible exception of a few of the older abandoned wells, is believed to be a complete résumé of developments in this county to the end of 1911. Taking the record as a whole, some interesting and valuable conclusions may be drawn.

Since 1865, when the first known wells were drilled on the Ex-Mission grant, 682 wells have been drilled within the limits of this county, almost all of these in the valley of the Santa Clara River, or rather in the hills immediately adjacent. These wells may be divided as follows:

9 wells are commercial producers of gas.
122 wells were abandoned without discovering any oil.
42 found some oil, but not in profitable quantity.
139 were abandoned for reasons not now discoverable.
87 were produced for a time, and abandoned as exhausted or unprofitable, or because of accident to the hole.
52 are now on the pump, producing oil which may be classed as fuel—the dividing line being taken at 18° Beaumé.
231 are producing oil of refining value, which brings a price above that obtainable for fuel oil.
50 wells now drilling (December, 1910) are not included in the above total.

The production of the county for the year 1910 was 492,147 barrels, having an estimated value of $319,898. Taking the above total for number of producing wells, the output per well was 1740 barrels per annum, or 4 8/10 barrels per day, with an average value for the year of $1130, or almost exactly 65 cents per barrel.

There is some reason to think that this average output in barrels is correct for both light oil and heavy oil production, as while there is a great difference between individual wells in daily output, it is probable that the average production per well in each class is about the same. But when we figure on the value of this output, the price of refining oil is so much higher than that of fuel that the light oil wells are, as a rule, much better producers in point of value. It will not be far from the mark to take the average annual product per well for the county at a value of $1210 for light oil production, and of $780 for heavy oil production, equivalent to prices of 70 cents and 45 cents per barrel for the two grades.

The maintenance charge on most of the wells in this county is very small, due both to their slight depth and to the firmness of the formation penetrated and from which the oil is drawn. With but few exceptions, running sands are unknown, water troubles are the exception rather than the rule, and emulsified oil is not found. While, of course, it is impossible to fix on any operating cost which will represent the facts as regards all leases, it is probable that the actual cost of producing the average Ventura County well is not over $400 per annum.

The most apparent fact regarding this territory, and one which can not be denied, is that it is extremely patchy, there being no large producing areas whatever. As already stated, this is due to the excessive folding and fracturing of all the formations from which oil is here drawn, and seems to apply to the entire county, with the possible exception of the Simi Valley. As this latter area is almost entirely untested, it may be found that like conditions obtain here also, but the geological indications are such that there is at least a chance for the development of more extended producing areas. This, however, remains to be seen.

This uncertainty makes prospecting extremely hazardous, as witness the very large percentage of failures. The development of the county has also been greatly retarded by the extreme roughness and inaccessibility of most of the possible territory. On the other hand, the oils developed are largely of such quality as find a ready sale at a good price, thus eliminating one very considerable hazard, and as there are everywhere exposures from which at least some deductions can be drawn, and as the usual high dip of the formation makes it possible to prospect with shallow holes, this territory has always been the favorite ground of small operators. This result has also been favored by the character of land titles, all land lying north of the floor of the valley being originally government land, large holdings being restricted to those of the Union and, later, the Scarab Oil Company. While it would be difficult, at the present time, to accumulate any large holdings in this county, small leases, both developed and prospective, may always be had at a fair price.

The development of the county as an oil producer has been greatly hindered by the exclusive ownership of large acreages of the choicest territory by the two companies mentioned above, and it is highly probable that so long as they hold to a policy of neither developing nor leasing, the annual output of the county will not be very greatly increased. The area of prospective undeveloped territory held by these two companies must be at least equal to the area of all the territory now developed, or which could be classed as reasonably favorable, in the hands of other parties. Nevertheless, very considerable areas yet remain untested or only partly prospected, and while there is little reason to

look for anything sensational in the way of new development nor for any sudden increase in the output of the county, yet, when we consider the remarkably permanent character of such production as is gained, it is highly probable that the output of the county will show a steady growth for many years to come, and that the present producing areas will be very materially increased, both by new discoveries and by extensions.

A count of the wells in Ventura County, made in March, 1912, gives the following figures:

Wells producing gas in commercial quantities	9
Wells producing oil above 18° Beaumé	283
Wells producing oil below 18° Beaumé	39
Dry holes, abandoned	130
Wells showing some oil, abandoned	64
Exhausted producers, abandoned	81
Wells abandoned for unknown reasons	101
Wells capable of production, suspended	9
Drilling wells suspended	10
Wells now drilling, March 1, 1912	37
Total number of wells in county	763

There are also some abandoned holes, drilled at very early dates, of which no clear record now remains. The number of these is estimated at from twenty to thirty. Only the wells described in the text are included in this list.

CHAPTER X.

LOS ANGELES COUNTY.

The county of Los Angeles contains within its area three producing oil districts, as follows:

The Newhall field, of which Castaic, Pico Cañon, Elsmere Cañon, Placerita and Tujunga are subdivisions. This field is an extension of the Ventura County deposits, and extends up both sides of the Santa Clara Valley from the county line to the town of Newhall, with extensions to the east into Elsmere and Placerita cañons, and, with a slight break, to the southeast into Tujunga Cañon.

The Los Angeles field, comprising the "City Field" and Salt Lake or Sherman. The eastern end of these fields is located in the northern portion of the city of Los Angeles, and the producing strip extends therefrom almost to the ocean, in a southwesterly direction.

The Puente Hills district, variously divided, but covering the better known Whittier, Puente, La Habra, Coyote, Olinda, Brea Cañon, and Fullerton fields. The Puente Hills district commences at the town of Whittier, some twelve miles southeast of Los Angeles City, and extends therefrom, in a generally easterly direction, across the county line. Fullerton is entirely in Orange County, but is so closely connected with the Whittier and Puente deposits, both geologically and commercially, that it is here considered as a whole in connection with Los Angeles County.

Outside of these producing districts, oil has been sought at a number of points in and around Los Angeles County, but without success to the present time. These locations are: At Lancaster and Mojave, in the northern portion of the county; in the Santa Monica mountains, west of the city, and south of the Ventura-Newhall district; north and south of the Los Angeles City field, and between the wells of the city tier; at Redondo, Manhattan, and San Pedro, on the coast south of the city of Los Angeles, and at Newport, on the coast of Orange County.

In the following pages these fields will be found described in the order given, under appropriate chapter headings.

NEWHALL FIELD.

The Newhall oil field is, commercially, an extension to the eastward of the deposits found on both sides of the Santa Clara Valley in Ventura County. While there may be some slight geological division between the Tapo wells and those of Pico, on the south side of the valley, no such separation is apparent on the north side, and thus the division at the county line is purely an arbitrary one.

The Pico field, or Newhall proper, commences at the county line, in township 3–17, and extends to and across township 3–16, covering the wells in Pico, Towsley, Wiley, Rice and East cañons, on the south side of the river.

North of the river, some prospecting has been done in township 4–17, but without result in the way of production, and has never been carried into township 4–16.

The Castaic group of four wells is located on the west line of township 5–16, at the junction of Elizabeth and Castaic creeks.

The Elsmere group of wells, and the prospect holes of Placerita Cañon, are found in township 3–15 and along the east line of township 3–16, which forces us to consider these townships as a unit.

The Tujunga group of prospect holes, none of which are productive, is found in townships 3–14 and 3–13, the wells lying in Pacoima, and in Little and Big Tujunga cañons.

This entire territory, covering an irregular strip with a length of over twenty miles, and a width of three or four miles, is of great similarity throughout as regards topography. In many ways it is similar to the southern portion of Ventura County, but is even more rugged, the Pico Cañon country in particular being actually mountainous. It is a barren, waterless country, in parts bare, in parts covered with low but dense brush, and excepting the small areas of river and creek bottom, has a soil composed largely of sandstone and shale detritus, barren and unfruitful. The climate, as might be expected, is hot and dry, with comparatively small rainfall, and that occurring exclusively in winter.

This country is served by one railroad running approximately parallel to its length, but even with this, it suffers somewhat from lack of transportation facilities. Parts of the Newhall field are too rough to be reached by roads, others are accessible only by means of long and heavy grades. Castaic has a good road up the valley of Castaic Creek; Elsmere lies adjacent to the railroad, and Placerita Cañon has a fairly level but very soft road. Tujunga cañon proper is reached by a fair road from the town of Fernando, but the more northern prospects in this region had to build roads through very rough hills at considerable expense.

Geologically this country greatly resembles the territory north of Santa Clara River, consisting largely of hard sandstones and shales, the former predominating, and being characterized by excessive folding and fracturing. The same causes have brought about like results in these two fields, the oils produced being of very diverse qualities, and found only in small pools, production of single wells being rather small, but usually long lived.

The well records hereafter presented for this field are less complete than could be desired, great difficulty being experienced, in the sparsely

settled western end, in getting any data whatever about some of the older wells. In this end of the field, also, an unusual and incomprehensible secrecy seems to be the rule, which was not the case in the eastern end of the field, where the fullest information was, in almost every case, freely given.

Wells in Township 4–17.

But three wells have been drilled in this township, so far as can be learned. In this connection the records of the Temescal wells should be examined, these lying on the same general formation.

East Piru Oil Company. This company was drilling, in the year 1900, just north of Leckler Cañon, near the center of section 6. The results of this work are not known.

Ætna Oil Company. This company has two wells on the southeast quarter of the northwest quarter of section 8, drilled about 1901. Well No. 1 was 845 feet deep, and was abandoned because of collapsed casing, with a good showing of oil in the hole. No. 2, however, a little to the southeast, was carried to 960 feet without finding the sand, and was abandoned as a dry hole.

Wells in Townships 5–17 and 5–16.

Castaic Oil Company. This well was drilled on the north side of Palomas Cañon, on the east line of section 23, 5–17, in the year 1901. It is reported to have been approximately 1000 feet deep, and had a twenty-foot streak of dry asphalt at 600 feet. This hole is said to have been drilled without casing.

Castaic Oil Association. This company drilled a well on the east side of Castaic Cañon, just below the entrance of Elizabeth Cañon, and on the southwest quarter of section 18, 5–16, in the year 1899. The depth of this hole was slightly in excess of 1400 feet; no oil was found, but considerable gas.

Rose Oil Company. In 1904 this company drilled a well just to the south of the foregoing, carrying it to a depth of 1700 feet, and abandoning it owing to mechanical difficulties. This hole developed some high-gravity oil, which is now flowing from the casing head.

New Castaic Oil Company. This company has been drilling for many months on the northwest quarter of section 19 in 5–16. In February, 1912, this hole was reported to be down 2500 feet and drilling, with a strong showing of gas and some indications of oil.

A small but very perfect and well-marked anticlinal fold shows on both sides of Castaic Creek at this point, and reappears in Charley Cañon, about a mile to the east. The Rose well appears to have been almost exactly on the axis of this fold—the New Castaic well is some distance out on the south limb, which at the surface, at least, has a sharp dip.

Looking up Castaic Cañon from above New Castaic Location.

Anticlinal Fold in Charley Cañon, Los Angeles County. This Fold Reappears Two Miles Distant in Castaic Cañon.

Wells in Pico Cañon.

The operations of Pico Cañon were among the earliest successful attempts to produce oil in California. As early as 1850 Andreas Pico had been collecting seepage oil, which he distilled with a copper still and worm, making burning oil for the San Fernando Mission, and in later years oil so collected was shipped by wagon to Polhemus refinery at Los Angeles, and even to the Metropolitan Gas Works at San Francisco. It is recorded that on January 28, 1867, twelve barrels of oil were shipped from Pico Cañon, and in 1874 the output is said to have been as high as ten barrels per day, this being entirely seepage oil.

A well is said to have been drilled in this cañon, by the old spring-pole method, as early as 1869. This well found an encouraging amount of oil (it is hardly likely that the original statement that this was a "flowing well" is literally true), but the hole was spoiled at a depth of 140 feet.

The first producing well at this location was drilled by the California Star Oil Company, of Los Angeles, on the Pico claim, in 1875. In September, 1879, the Pacific Coast Oil Company was incorporated, and commenced drilling on the Menlo claim, just east of the Pico, shortly extending its operations to the Belmost claim, still farther east. This company soon afterward absorbed the Star company, but the numbering of the wells appears to have been kept separate at all times.

In 1882 or 1883 the Hardison & Stewart Oil Company leased what was known as the Hill tract, not now definitely bounded, but located generally south and east of the wells then existing. On this tract they drilled three wells, two of which were dry, the third a small producer, but soon ruined by water. This company also drilled Star No. 1 in Pico Cañon, and two or three wells in DeWitt Cañon.

The rate at which developments proceeded in Pico Cañon will be shown by the tabular list of the older wells, as below. In the year 1902 the entire property of the Pacific Coast Oil Company, covering perhaps half the total area of the entire Newhall field, passed to the Standard Oil Company of California.

Well Records. The total number of wells in the Pico Cañon group, so far as can now be determined, is seventy-eight, of which one is on Rancho Simi; thirty-six are on the Pico claim; eighteen on the Menlo claim, and twenty-three on the Belmont claim. Of the seventy-eight, forty-three were producing in January, 1911, two were drilling, and thirty-three had been abandoned for various reasons. Of wells later than No. 19 on the Pico, and No. 20 on the Menlo and Belmont claims (these latter being numbered together), almost nothing is known. On the contrary, the records of the earlier wells are so unusually complete and entirely authentic that they are here given in detail. It is believed that a care-

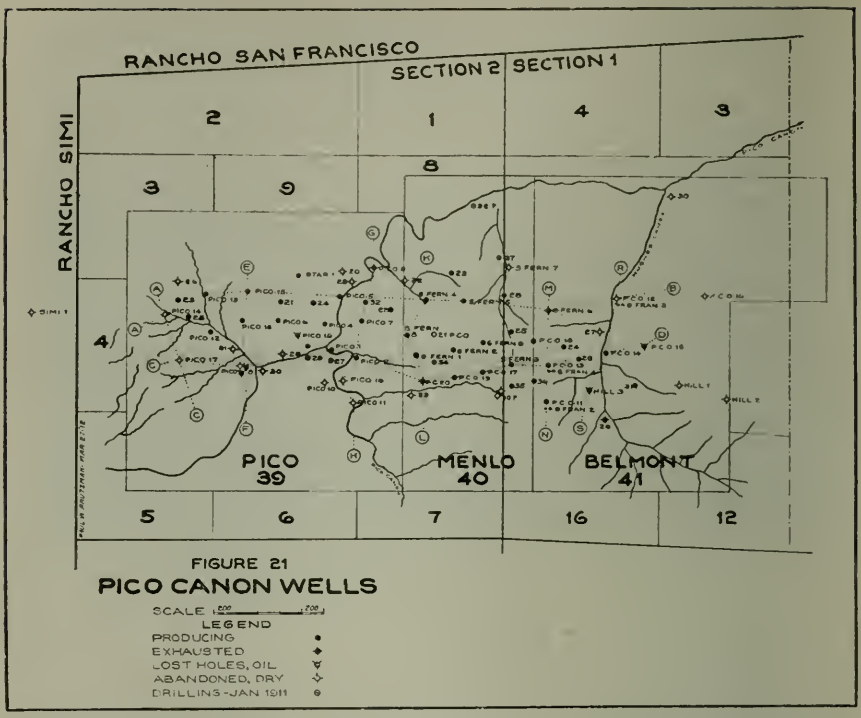


FIGURE 21

PICO CANON WELLS

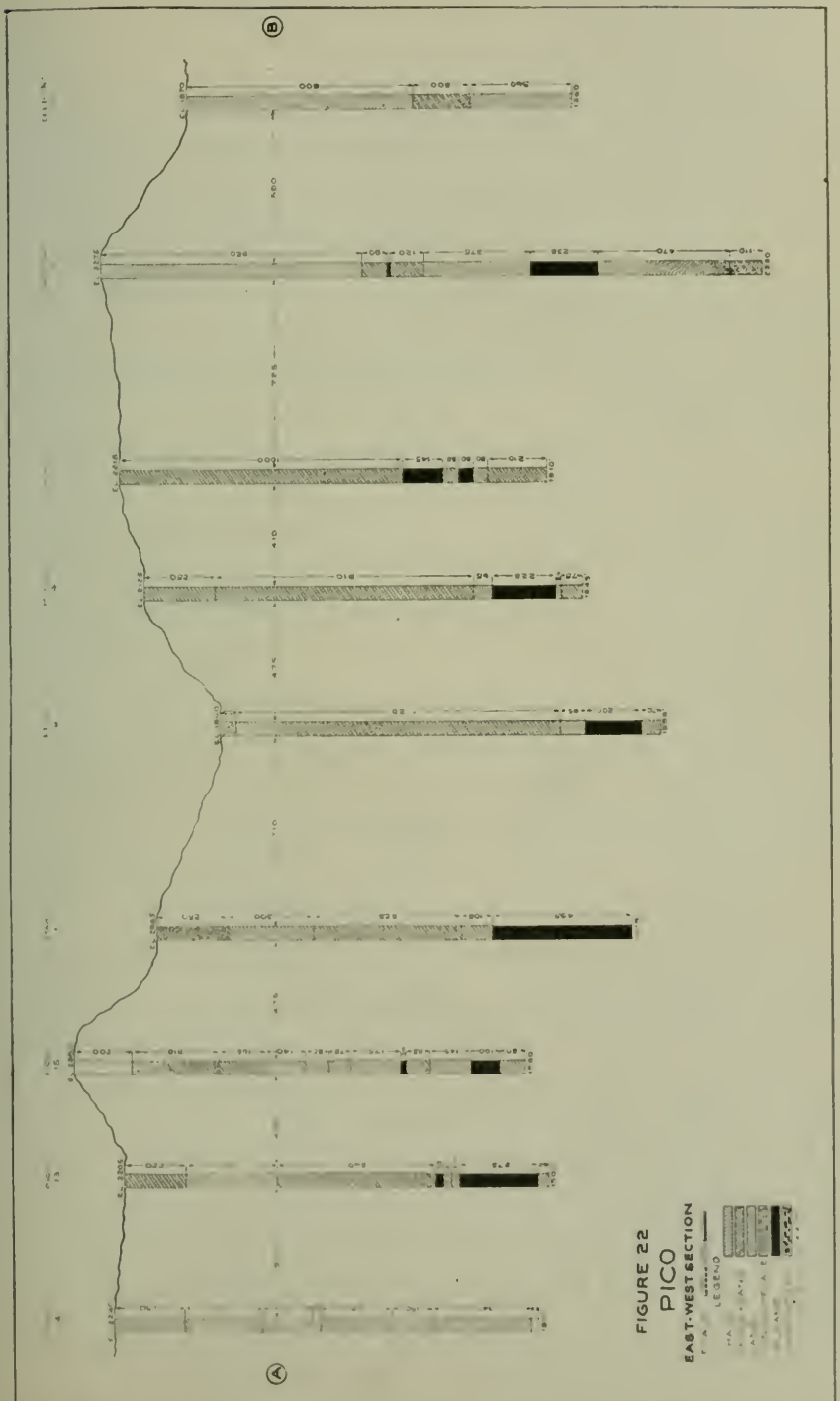
ful study of these notes will throw some light on conditions prevailing in Pico, and by analogy on conditions at other points along the so-called "Pico anticline."

The numbering of these wells is somewhat complicated, as various series of numbers have been started at different times, and later merged in other series. Fortunately, however, with but one exception, no two wells having the same number have been located in any one claim, and the claim name and the present series number are, therefore, in all cases, sufficient identification. In the following table both the present number and the older number, if any, are given:

Tabular List of Pico Cañon Wells.

From original records.

Present number.	Claim.	Old number.	Year.	Depth	Remarks.
Star 1	Pico		1883	1650	Drilled by Hardison & Stewart. 30 barrels per day in 1887. Still producing.
Pico 1	Pico		1875	700	5 barrels per day in 1887. Still producing. Drew its oil from close to surface. Craig says in "break."
Pico 2	Pico		1875	900	5 barrels per day in 1887. Still producing. Got oil both farther up and farther down than No. 1.
Pico 3	Pico				Not accounted for in 1887.


B
A
FIGURE 22
PICO
EAST-WEST SECTION
LEGEND

Tabular List of Pico Cañon Wells—Continued.

From original records.

Present number.	Claim.	Old number.	Year.	Depth	Remarks.
Pico 4	Pico		1876	1000	30 barrels in 1887. Yielded 75 barrels at first, at 600 feet, but fell off to 14 barrels and was then deepened. Still producing.
Pico 5	Pico		1880	1100	25 barrels in 1887. Still producing. 100 feet north of "break."
Pico 6	Pico		1880	1500	25 barrels in 1887. Still producing. 300 feet north of "break."
Pico 7	Pico		1882	1200	Flowing 40 barrels in 1887. Still producing.
Pico 8a	Pico		1882	500	Spoiled hole, dry.
Pico 8b	Pico		1882	1000	Produced 5 or barrels for a short time, then went dry. Say 200 feet south of "break."
Pico 8c	Pico		1882	1500	Located close to 8b. Dry hole.
Pico 9	Pico		1882	1550	35 barrels per day in 1887. 500 feet north of "break." Oil from bottom of hole. Abandoned since 1890.
Pico 10	Pico		1882	900	Tools lost at this depth; never produced; flowing trace of oil in 1887. 150 feet south of "break."
Pico 11	Pico		1882	1500	Fresh water, a little tar, and a little gas. Dry hole. 250 feet south of "break."
Pico 12	Pico		1883	1300	18 barrels per day in 1887. Heavier oil than balance of wells, also more paraffin and more gas. North of "break." Still producing.
Pico 13	Pico		1883	1600	40 barrels in 1887. Heavier oil than balance of wells, also more paraffin and more gas. North of "break." Still producing.
Pico 14	Pico		1883	1500	Dry hole. Probably south of "break."
Pico 15	Pico		1888	1590	Oil near bottom of well. Still producing.
Pico 16	Pico		1888	940	A thin streak of sand, and below this sand with a little oil. Abandoned when drilled. South of "break."
Pico 17	Pico		1889	810	Some oil near bottom. Lost in running sand. Abandoned when drilled.
Pico 18	Pico		1889	1128	Two strata oil. Still producing.
Pico 19	Pico		1889	800	Diamond drill hole; spoiled. Ten or more streaks oil sand. Abandoned when drilled. Very small producer.
Pico 20	Pico				Abandoned hole. No data.
Pico 21	Pico				Producer. No data.
Pico 22	Pico				Producer. No data.
Pico 23	Pico				Producer. No data.
Pico 24	Pico				Producer. No data.
Pico 25	Pico				Producer. No data.
Pico 26	Pico				Abandoned hole. No data.
Pico 27	Pico				Producer. No data.
Pico 28	Pico				Abandoned hole. No data.
Pico 29	Pico				Abandoned hole. No data.
Pico 30	Pico				Abandoned hole. No data.
Pico 31	Pico				Abandoned hole. No data.
Pico 32	Pico				Producer. No data.
Pico 33 (?)	Pico				A producer, north of No. 29, shown on Standard's 1910 map, not numbered.

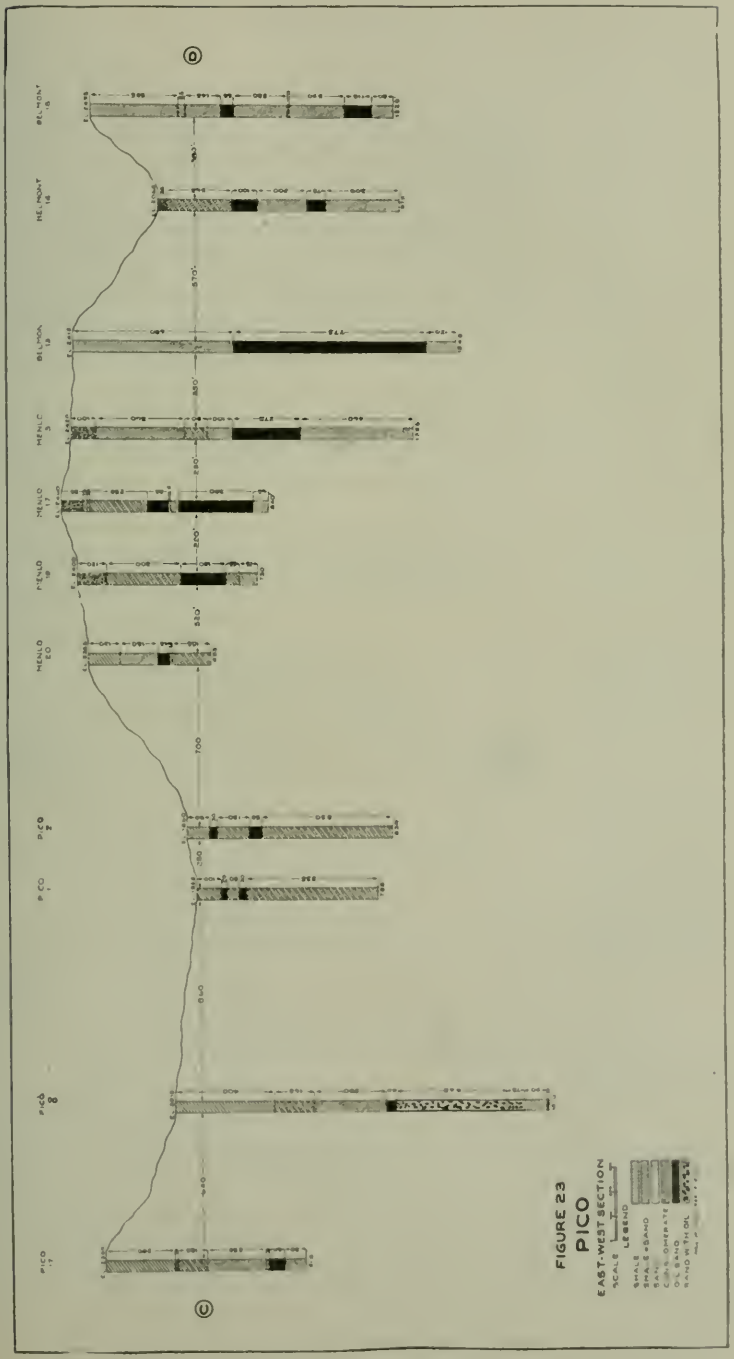


FIGURE 23
PICO
EAST-WEST SECTION
SCALE
LEGEND

Tabular List of Pico Cañon Wells—Continued.

From original records.

Present number.	Claim.	Old number.	Year.	Depth	Remarks.
P. C. O. Co. 1	Menlo	San Fernando 1	1882	1176	20 barrels per day in 1887. Still producing.
P. C. O. Co. 2	Menlo	San Fernando 2	1882	1450	40 barrels per day in 1887. Still producing.
P. C. O. Co. 3	Menlo	San Fernando 3	1882	1375	25 barrels per day in 1887. Still producing.
P. C. O. Co. 4	Menlo	San Fernando 4	1882	1555	18 barrels per day in 1887. Still producing.
P. C. O. Co. 5	Menlo	San Fernando 5	1882	1600	15 barrels per day in 1887. Still producing.
P. C. O. Co. 6	Belmont	San Fernando 6	1882	2330	10 barrels in 1887. Still producing.
P. C. O. Co. 7	Belmont	San Fernando 7	1882	1900	Dry hole. Abandoned when drilled. Slight traces of black oil.
P. C. O. Co. 8	Menlo	San Fernando 8	1887	1325	60 barrels per day in 1887. Still producing.
P. C. O. Co. 9	Menlo	San Fernando 9	1887	1065	Still producing.
P. C. O. Co. 10	Menlo	San Francisco 1	1880	------	Dry hole; abandoned when drilled. Location on map uncertain.
P. C. O. Co. 11	Belmont	San Francisco 2	1881	1515	5 barrels per day in 1887. Still producing.
P. C. O. Co. 12	Belmont	San Francisco 3	1883	1360	Dry hole; no oil whatever. Abandoned when drilled.
P. C. O. Co. 13	Belmont	San Francisco 4	1883	1550	40 barrels per day in 1887. Still producing.
P. C. O. Co. 14	Belmont	----------	1888	975	Still producing.
P. C. O. Co. 15	Belmont	----------	1888	1220	Normal amount oil, drowned out by upper water. Abandoned when drilled.
P. C. O. Co. 16	Belmont	----------	1888	------	Abandoned hole. No data.
P. C. O. Co. 17	Menlo	----------	1889	840	Still producing.
P. C. O. Co. 18	Belmont	----------	1889	1200	Still producing.
P. C. O. Co. 19	Menlo	----------	1889	730	Still producing.
P. C. O. Co. 20	Menlo	----------	1889	495	Originally small producer. Abandoned since 1890.
P. C. O. Co. 21	Menlo	----------	------	------	Location uncertain. Probably once a producer; now abandoned.
P. C. O. Co. 22	Menlo	----------	------	------	Abandoned well. No data.
P. C. O. Co. 23	Menlo	----------	------	------	Producer. No data.
P. C. O. Co. 24	Belmont	----------	------	------	Producer. No data.
P. C. O. Co. 25	Menlo	----------	------	------	Producer. No data.
P. C. O. Co. 26	Belmont	----------	------	------	Abandoned well. No data.
P. C. O. Co. 27	Belmont	----------	------	------	Abandoned well. No data.
P. C. O. Co. 28	Menlo	----------	------	------	Producer. No data.
P. C. O. Co. 29	Belmont	----------	------	------	Producer. No data.
P. C. O. Co. 30	Belmont	----------	------	------	Abandoned well. No data.
P. C. O. Co. 31	Belmont	----------	------	------	Abandoneed well. No data.
P. C. O. Co. 32	Menlo	----------	------	------	Location uncertain. A well taken to be No. 32 was drilling at the beginning of 1911.
P. C. O. Co. 33	Menlo	----------	------	------	Abandoned well. No data.
P. C. O. Co. 34	Menlo	----------	------	------	Producer. No data.
P. C. O. Co. 35	Menlo	----------	------	------	Producer. No data.
P. C. O. Co. 36	Belmont	----------	------	------	Producer. No data.
P. C. O. Co. 37	Menlo	----------	------	------	Drilling at the beginning of 1911. Said to be a very deep hole, with considerable oil.
Hill 1	Belmont	----------	1883	1800	Dry hole. Abandoned when drilled.
Hill 2	Belmont	----------	1883	1200	Dry hole. Abandoned when drilled.
Hill 3	Belmont	----------	1883	1550	No oil sand, but streaks of oil under shells. Pumped 5 barrels per day for a time; ruined by upper water breaking in.
Simi 1	Rancho Simi	----------	1884	1300	Dry hole; no oil whatever. Abandoned when drilled.

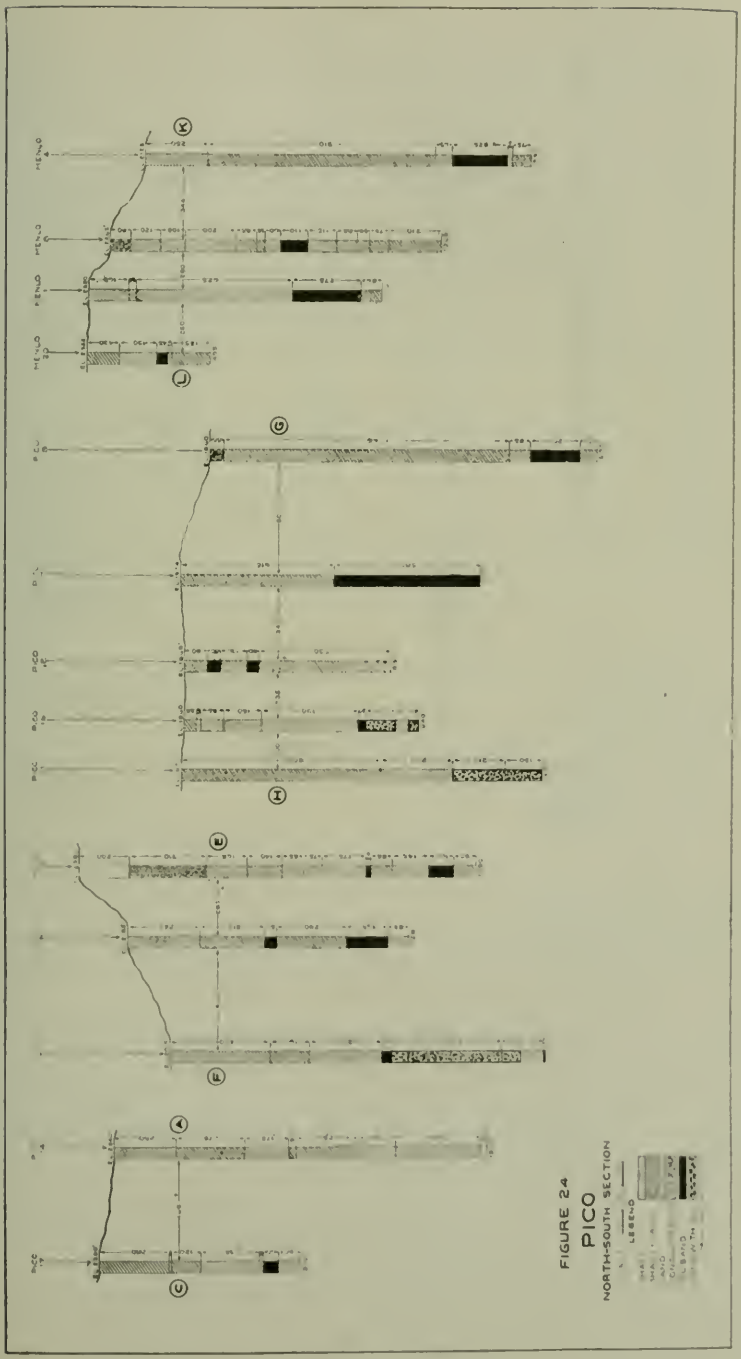
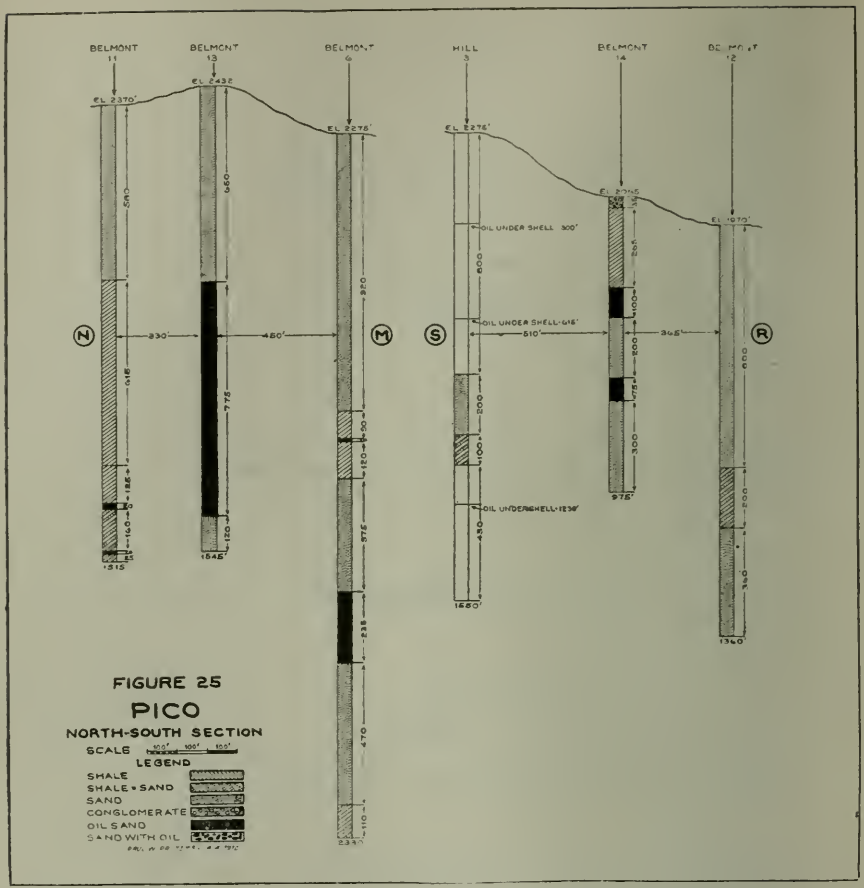


FIGURE 24
PICO
NORTH-SOUTH SECTION



Wells in DeWitt Cañon.

Seven wells appear to have been drilled in DeWitt, or to give it the old name, Little Moore Cañon. Of these, records can be found for but three.

The first two wells were drilled by the Hardison & Stewart Oil Company in 1882 and 1883. No. 1 was about 1000 feet deep, and found a small quantity, say about one barrel per day, of a black oil of some 24° Beaumé. An analysis of this oil is given in connection with those of Pico oils. This well is still flowing slowly.

No. 2 was either 700 or 1100 feet deep, probably the former, and is said to have been a perfectly dry hole. This is down the cañon from No. 1, both being in the east fork of the cañon.

No. 3 is also said to have been drilled by the Hardison & Stewart Oil Company, but as this well is not mentioned in the 1887 report of the State Mineralogist, this statement appears to be doubtful. This hole

is reported locally to have been 1600 feet deep, and to have found some oil. It is in the west fork of the cañon.

Nothing whatever can at present be learned as to the other four wells, which were probably drilled by the Pacific Coast Oil Company. These wells are on the Arcadia and Camulos claims, in the north half of section 7, 3–16.

The DeWitt wells seem to have been some distance out on the north-dipping formation, at least one half mile north-northeast of the fault line running from Pico to Wiley, and are probably on a small secondary fold or fault which shows for some distance farther east.

Wells in Towsley Cañon.

Eleven wells are in evidence in Towsley Cañon or on the hills immediately adjacent, but the records are fragmentary and confused. No work is mentioned in any of the older reports before 1893, yet it is highly probable that the two wells on the Temple claim are of considerably greater age.

The first recorded work was done by the Washington Oil Company in 1893 and 1894. The first well of this company, drilled immediately on the outcrop, was 200 feet deep, and found a little heavy black oil, presumably heavy only as compared with the light oils of Pico. The second well was about 400 feet deep, and got the same results. The third well of this company was farther down the dip, and when reported in 1894 had found some green oil of about 30° Beaume at a depth of 600 feet. The final depth of this well is not known, but probably approximated 1000 feet. The rig was burned and the company went into bankruptcy.

A well drilled by Boyle & Thompson, in 1897, is said to have been 1035 feet deep, and to have passed through six streaks of oil.

Another well, drilled by parties unknown, in the same locality, but in the following year, is said to have gone through brown shale and sand to a depth of 1320 feet, where flowing oil was struck. Presumably this was of short duration, as the well was never produced.

A well was drilled by Clark, Sherman & Co., in the year 1896, to a depth variously reported at 900 and 1600 feet. This accounts for six of the eight wells which may be observed on the east side of the cañon, on the Towsley oil claim, northeast quarter of section 17. Two or three of these old wells are now seeping a little oil ranging between 20° and 30° Beaumé, and from these enough oil is taken to supply the drilling rig now working in the cañon.

Consolidated Midway Chief Oil Company is now working close to the bottom of the cañon, and to the southwest of the old wells. Early in the current year this well had reached a depth of some 600 feet, and

had passed through several oil streaks, but had not enough oil to make a producer.

Towsley Cañon Oil Company drilled a well in the year 1902, on the west side of the cañon, and just south of the line of the Towsley claim. This well was 980 feet deep, and was a crooked hole. A little oil was found.

St. Bernard Oil Company. The well of this company is in the west fork of the cañon, and nearly a mile and a half, following the windings of the gulch, above the other wells. This well was drilled in 1903, to a depth of 2100 feet, and is said to have encountered oil at several levels, but with no production. In 1911 this well was reported to be again drilling, but was not visited.

The Towsley Cañon wells seem to be on the main fault line running from Pico to Wiley, but were located where there was a great deal of local crumpling. While most if not all of these wells found a little oil, there is no indication that any of them found any real producing formation, and it is highly probable that all were located immediately in the fault zone. The apparent line of outcrop of the north-dipping formation cuts through the group of wells near its southern margin, but there is no way to determine the vertical angle of the fault line, nor the width of the crushed strip. It would appear that the best prospects, reasoning at least from the results at Pico, would lie farther out on the north dip, and even though a deeper hole were required to reach the sands, this would be offset by the greater ease of drilling in unshattered formation.

Wells in Wiley Cañon.

Seventeen or more wells have been drilled in this cañon, but little information regarding them can be had. Prior to 1887, two wells had been drilled here, one about 900, the other 1325 feet deep. Each of these wells is recorded as having given a small quantity of dark green 36° oil, but no production.

In 1910, seven wells in this cañon were producing, two were unfinished, and seven had been abandoned. No. 13, the farthest well to the southeast, was reported to be a very good producer at some 1800 feet. This well flowed by heads while being drilled. The wells on the hill immediately below this are said to be 1300 to 1400 feet deep. The drilling well farthest to the north, down the cañon, was said to be some 1500 feet at that time, but the expectation was to carry it to 2000 feet. The first thirteen wells were reported in 1900 to range from 600 to 1626 feet in depth. At that time only three of these wells were productive.

At least the older wells in this cañon are very small producers, and are pumped but twice a week. It appears to be characteristic of these wells that they start off with a good production, but dwindle very

rapidly, this being in strong contrast with the behavior of the Pico Cañon wells. No reliable estimate of the gross production of this group of wells can be had, but it is probably small. These wells are situated near the center of section 16, 3–16, along the line of the main fault, and are the property of the Standard Oil Company of California. The older wells were drilled by the Pacific Coast Oil Company, or its predecessors.

Wells in Rice Cañon.

Ten wells are known to have been drilled in Rice Cañon: two on property now belonging to the Standard Oil Company, seven on the W. P. Rice property, and one about one half mile farther up the cañon. All abandoned.

Standard Oil Company. The wells of this company are located, one on each side of the cañon, just north of the south line of section 15. Well No. 1 was drilled to 500 feet, No. 2 to 800 feet. The first is said to have been good for three barrels daily, the second was drowned by upper water.

Rice Cañon Oil Company. Seven wells were drilled by this corporation, on the northeast quarter of the northwest quarter of section 22, but these are now the property of W. P. Rice of Summerfield, Massachusetts. These wells were drilled in 1889 and 1890, and are said to range from 800 to 1600 feet, though most of them are of the minimum depth. These wells made a little oil of about 30° gravity, but a good deal of water also, and are not now operating.

Newhall Mountain Oil Company. The well of this company, on the northwest quarter of the northeast quarter of section 21, was drilled to a depth of 1800 feet without finding any indications of oil.

The Newhall well was far to the south of the fault line, and on south-dipping formation. The Rice wells appear to be located immediately in the fault zone, which would account for the water. The Standard wells are a short distance out on north-dipping formation.

Wells in East Cañon.

But two wells are reported in this cañon, both on the west side, and both abandoned.

Bradshaw & Beville. This well is on the southeast quarter of the northeast quarter of section 22, and apparently almost on the outcrop of the north-dipping strata. It was carried to a depth somewhat in excess of 800 feet, and it is said to have had a very good showing of 18° gravity oil near the bottom, but encountered flowing water immediately beneath the oil.

Grapevine Cañon Oil Company. The well of this corporation is on the forty immediately north of the above, and was drilled in 1901. It

was pointed and abandoned at 1300 feet, and seems to have been entirely barren. It was probably too far out on the north dip to reach the productive sands, if any, at this depth.

Wells in Leaming Cañon.

Two wells are known to have been located in this cañon, but both were shallow, and can hardly be considered as tests.

Dividend Oil Company. The well of this company was near the south line of section 10, and about one eighth mile from the east line of the section. It was carried to a depth of about 700 feet, and had no signs of oil.

California Oil Company. This company, which also drilled on section 18, 3–15, has a 400-foot abandoned well south of the cañon, in the northeast quarter of section 14. As might be expected, no oil was encountered at this depth.

These wells appear, superficially at least, to be on a secondary fold, or fault, roughly parallel to the main Pico-Wiley fault. The possible productiveness of this fold remains to be proven.

Wells in Elsmere and Newhall Cañons.

The group of heavy oil wells generally known as the Elsmere wells are found in the three branches of the upper cañon of Newhall Creek. The northeast branch of this cañon, not named on the maps, but known locally as Mud Springs Cañon, follows closely the north line of section 7, 3–15, and joins Newhall Creek about one and one half miles above (southeast of) the town of Newhall. Elsmere Cañon heads near the southeast corner of section 18, in the same township, and takes a northwesterly course to join Newhall Creek a short distance above the junction of Mud Springs Cañon. Newhall Creek takes a rise near the center of the east line of section 13, 3–16, and flows almost due to north to the junction of Mud Springs Cañon, whence it trends northwest to join the Santa Clara River near Saugus.

Between Mud Springs and Elsmere cañons the hills are low and rounded, but between Elsmere and Newhall cañons is a high and very steep ridge, almost precipitous on its east face, somewhat more gentle to the west, and ending abruptly near the center of the west line of section 7. The wells in Mud Springs Cañon are some distance from those of Elsmere, but the latter have been carried up and over the ridge, and cannot be divided from the wells in Newhall Cañon. As there is some reason for believing that all the wells in these two cañons enter a common formation, they will here be described as a single group.

Pearl Oil Company. Well No. 1 of this company is the most southerly in this group, the Enterprise, Alliance and Padua wells being south of the divide. This well is immediately at the head of Newhall Cañon,

Pico Cañon, Newhall, Los Angeles County.

Wells in Newhall Cañon, Newhall, Los Angeles County.

and close to the summit of the range. It was drilled in 1901 to a depth of 1050 feet, and had about 35 feet of oil sand. This, however, was found close to the surface, and was not productive enough to justify pumping, and the well was abandoned.

Well No. 2 was located west of the San Fernando road, and some distance down the mountain from No. 1. This well was abandoned at 600 feet because of upper water, which could not be shut off.

Well No. 3 is east of No. 2, immediately on the county road, and close to both the grant line and the producing wells north. This well was drilled to 2015 feet in the year 1903. It found the upper sands, those from which the wells immediately north produce, in place at a slight depth, but these were not sufficiently productive to justify operation, and nothing was found below. This test is of considerable interest, as it shows the southern limit of producing values in the upper sands, and indicates the lack of any oil-bearing strata at greater depth.

Zenith Oil Company. This company, a Los Angeles corporation, and not identical with the Zenith Oil Company of Maine, which operated in the early years at Coalinga, has four abandoned and four producing wells on the Rancho San Francisco, in the cañon of Newhall Creek, and immediately at the foot of Elsmere Ridge. Of the first three nothing is known; drilling had begun in 1900, and two had already been abandoned in 1903.

The present group of producers is found near the southern extremity of the grant, and immediately west of the Commercial and Eureka wells. Well No. 1 is 630 feet, and No. 2 is 645 feet deep, and are producers. No. 3 was drilled to 925 feet, found the sand as in adjacent wells, but was ruined by top water, and abandoned. No. 4 is a producer at 760 feet, and No. 5 at 740 feet. The four producers are all on the jack, but were shut down when visited. The oil in the tanks is a black oil of some 15° Beaumé, and of less viscosity than the oil from the ridge wells (see analysis.) These wells are said to be small but steady producers.

San Miguel Oil and Development Company—Newhall Petroleum Company. This well was drilled, or at least started, by the San Miguel Oil and Development Company, which also operated in Placerita Cañon. Later the property was leased to the Newhall Petroleum Company, but has now reverted to the original owner, Mr. H. Clay Needham of Newhall. This well was drilled in 1903 to a depth of 1500 feet, and was pumped for a time, but afterward abandoned. This well is said to have found water in the sands producing oil farther to the east, and to have made a mixture of water and oil, indicating that permanent water level had been reached in this direction.

Safe Oil Company. This company operated in 1901 on the small tract just west of the Santa Ana wells. The hole was slightly less than

1000 feet in depth, and found a small quantity of heavy tar, too stiff to pump, at the bottom. It was the opinion of local operators at the time that this hole was then immediately above the sands found in the Santa Ana wells. The rig is still in place, but no work has been done for many years.

E. A. & D. L. Clampitt—London Petroleum Company—Ventura Oil Development Company. The properties hereafter described under the names Alpine Oil Company, Santa Ana Oil Company, Commercial Oil Company and Eureka Crude Oil Company, were sold during 1908 to 1910 to E. A. and D. L. Clampitt of Los Angeles. Shortly after these properties were sold to the London Petroleum Company, but it is said that the purchase was never completed, and that the present title is in Clampitt Bros. During 1911 these leases were being operated by the Ventura Oil Development Company, an affiliated company of the London Petroleum Company.

Santa Ana Oil Company. The wells of this company are on the north half of Lot 3, section 12, 3–16. Well No. 1 was drilled in 1901, to a depth of 1009 feet, and was a producer. No. 2 was also a producer at 986 feet. No. 3 was drilled in 1902, to a depth of 875 feet, and was also a producer, though always a smaller well than the other two. These wells are small producers of a very heavy oil, gravity about 12° Beaumé. The Santa Ana Company also drilled in section 18, 3–15, and at Newport and in Ventura County (Piru).

Alpine Oil Company. These wells are on the south half of Lot 3, section 12. No. 1 was abandoned at 800 feet because of casing trouble, No. 2 is a producer at 800 feet, and No. 3 at 850 feet. These wells are also producers of very heavy black oil.

Commercial Oil Company. The wells of this company are on the north half of Lot 1, section 13, 3–16. Well No. 1 was abandoned at 700 feet because of casing trouble. Wells No. 2, No. 3, and No. 4 are all producers, at 1000 feet, 700 feet, and 700 feet, respectively. The oil from these wells is somewhat lighter than that from the Alpine and Santa Ana wells, but the production is small. These wells were drilled in 1901 and 1902.

Eureka Crude Oil Company. The wells drilled by this company are on the south half of the same lot, and were drilled in 1901. Well No. 1 is 800, No. 2 is 850 feet deep. Both are said to be capable of production, but were sanded up and not operating when last visited. These wells are at nearly the southern limit of production, and make but very little oil, even when in good condition. The oil is said to be similar to that from the Zenith wells.

Squaw Flat Oil Company. This company drilled in the year 1911, in the extreme northeast corner of section 18, 3–15. The well was 1205

feet deep, and found a fair stratum of oil sand, but not very productive, and when the rig was accidentally burned it was not replaced. This company are also operating in the Upper Sespe, Ventura County.

California Oil Company. The well drilled by this company was in the southwest corner of the northwest quarter of section 17, 3–15, in Elsmere Cañon, but nearly at the summit of the ridge. It was drilled in 1900, was about 1200 feet deep, and barren.

Graves Oil Company. This well is in the northwest quarter of the northwest quarter of section 17. It was drilled in 1900 to a depth of about 1500 feet, and is said to have gone into solid granite. It was a dry hole.

Good Luck Oil Company. The well of this company was drilled in 1900, on the hillside above the Standard's Elsmere wells, in the southeast quarter of section 7, 3–15. It is reported to have been 675 feet deep, and to have shown a little oil, and considerable water. Abandoned when drilled.

Standard Oil Company—Elsmere. On this tract there are twenty wells, of which eleven are more or less productive, while nine have been abandoned. The first well on this tract was drilled by the California Star Oil Company, then owners of the ground, in 1889. This well is said to have been 600 feet deep. Between this time and 1900, fifteen wells had been drilled, of which seven were productive in the latter year, and reported to yield from 7 to 45 barrels per day each. In 1903, shortly after the property passed to the Standard Oil Company, eleven wells were producing, and three suspended but rigged. This lease was allowed to stand idle for a considerable time, and no new work has been done for some years. The wells now pumping are on the jack, like all the wells on the ridge above it.

This group of wells is located in the cañon, and on the steep side of the ridge to the west. The evidences of a fault, of which the west is the up-thrust side, are very plain, and the abandoned wells farther to the east, including all but one east of the creek bed, appear to have been sunk in barren formation. The depth of these wells is not known, though it is said that the one farthest to the southeast (not exactly located, but described as in the flat below the California well, and probably in the northeast quarter of section 18), was carried to a depth of about 1800 feet, of which 1200 feet was in more or less solid, or at least unbroken, granite. West of the creek bed the wells range from 600 to 1200 feet in depth, the variation being approximately equal to the difference in level at the derrick floor. That is, the sands appeared to have a slight pitch only to the west. No detailed information is at hand from which the contour of the sands can be plotted, but the attached figure illustrates in a highly generalized manner the structure of the

country across Elsmere and Newhall cañons. The gravity of the average oil from this lease is about 14° Beaumé, the wells next to the fault line producing the heaviest oil, and those farthest to the southwest the lightest.

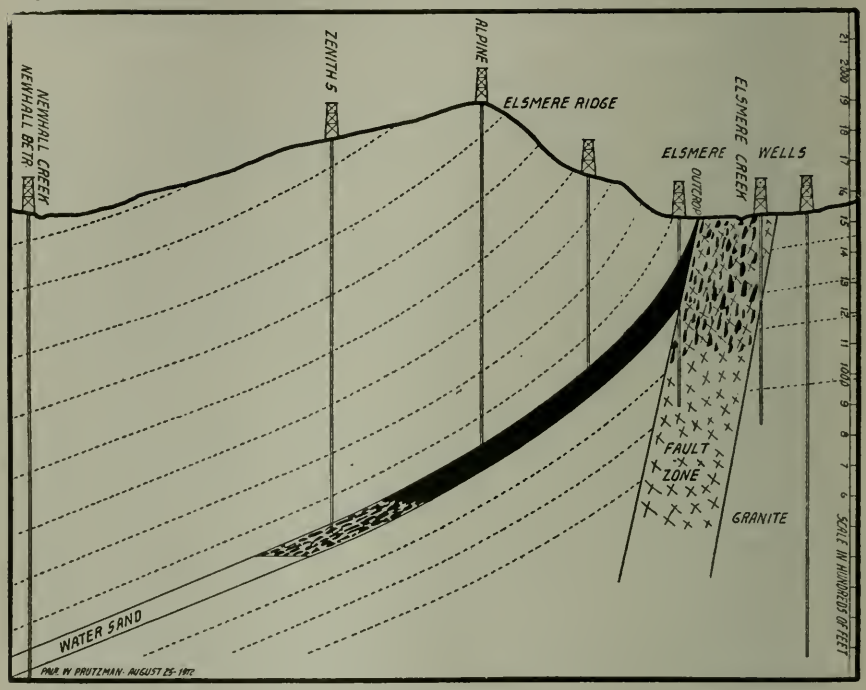


FIGURE 26.
Cross section, Elsmere and Newhall cañons.

Wells in Mud Springs Cañon.

Eight wells have been drilled in this cañon, of which two are now producing, four have made some oil, but have been lost for various reasons, and two were dry or practically so.

Connell, D. A. These wells are the private property of Mr. D. A. Connell, of Newhall, and are located on the southwest quarter of section 6, 3–15, on the floor of Mud Springs Cañon, and just north of the creek bed. The difference of elevation is slight. Well No. 1 is the farthest east, and is but a short distance from the Golden West well mentioned below. This well was drilled in 1908, to a depth of 950 feet. At about 500 feet a thin layer of sand was found, containing a little oil. The principal producing layer was met at 835 feet, and the well is now pumping from this sand, called locally the second sand. This was a fairly firm but soft sand, and gives a peculiar brownish-green oil some 17° Beaumé. The analyses of this and following oils are given below.

Well No. 2 found a heavy oil sand at some 600 feet, this being similar to and probably identical with the sand producing in No. 3. This sand

was not perforated, however, and the well was carried down in search of the sand producing in No. 1. This was found below 1000 feet, but less productive here than in No. 1, and at 1100 feet a quantity of water was struck and the well ruined.

Well No. 3 was carried through the first sand only, and was landed below it at about 600 feet. This sand is here quite productive, but gives a much heavier oil than is found in the second sand, and carries also some fresh water. This is considered to come from No. 2 well, or from one of the older wells to the east. No. 3 is pumping on the beam, and No. 1 on jack.

Golden West Oil Company. This well is just east of Connell No. 1, and at a slightly greater elevation, perhaps 50 feet. It was drilled in 1894, to a depth of 930 feet, and got a good producer in the second sand, the quality of the oil being about the same as that from Connell No. 1. This well is said to have pumped 250 barrels in the first four days, but upper water followed down, attempts to cement failed, and the hole was abandoned.

Banner Oil Company. This well is just east of the foregoing, and at about the same elevation. Nevertheless, it found what appears to be the second sand at about 800 feet, with considerable oil, but too much upper water to handle. This well was drilled in 1893, and was abandoned when the water (or quicksand) came in.

Nettleton & Kellerman Oil Company. The two wells of this company are a short distance southeast of the Connell wells, No. 1 at about the same level, No. 2 somewhat higher. No. 1 was drilled in 1899 to a depth of 1450 feet, and found two sands, which seem to be the second of the Connell wells, and a third sand not reached in [illegible] of these latter. Nothing corresponding to the first sand was passed in this well, but the second sand was found as a very thin layer, and but slightly productive. The oil from this sand is now flowing around the outer string, and though somewhat weathered, is very similar in appearance to the oil from Connell No. 1. At somewhere about 1100 feet a third producing stratum was reached, and the well flowed very strongly. For a time the well was an excellent producer, but fell off rapidly, and in the course of a few months was making but two or three barrels a day, which it maintained, being pumped at intervals until a short time since. After the production dwindled the well was deepened to 1450 feet, but went into hard rock (granite) without finding any further sands. The rig was finally burned off and never replaced, but the light oil from the third sand is still flowing slowly from the inner string. This is a bright-green oil of some 40° gravity.

Well No. 2 was drilled in the succeeding year, and found a little oil in the second sand, but no production, and did not find the third. The

depth of the hole was 1000 feet, which makes it rather uncertain whether it was deep enough to reach this formation. The owners of the property, however, believe that the light oil found in No. 1 well came from a crevice in hard rock, and that the production of this well does not argue the presence of a third producing sand.

Yankee Doodle Oil Company. This well was drilled in 1900, about three-eighths mile above the Kellerman wells, and on the south bank of the creek. It is reported that this well was 705 feet deep, and that it got some oil, but the latter statement may be questioned. The hole is now flowing a liberal stream of strong sulfur water.

Wells on the South Slope.

Several wells have been drilled on the south slope of the range, but none of these have developed profitable quantities of oil. The records, so far as they can be found, are as follows:

Padua Oil Company. This company drilled in 1900 on the Rinaldi tract, in the southwest quarter of the northwest quarter of section 24, 3–16. This well was about 1200 feet deep, and found a little oil near the surface, but nothing below.

Alliance Oil Company. A hole on the Weldon property, northeast quarter of the same section. This well was on the west side of San Fernando Cañon, and but a short distance east of the railroad, near the southern end of the tunnel. It appears to have been started in an outcrop, as it got traces of thick tarry oil near the surface, but nothing below. Total depth was 700 feet, drilled in 1901.

Enterprise Oil Company. The two wells of this company were very near the summit of the ridge, but slightly on the southern side, being on the northwest quarter of the southeast quarter of section 13, 3–16. Like the foregoing, they found a little oil near the surface, but nothing of commercial value, and each was carried to a depth of about 800 feet and abandoned.

Santa Ana Oil Company. This company (see, also, Elsmere) drilled a well on the southwest quarter of southeast quarter of section 18, 3–15, close to the summit of the ridge south of the Elsmere wells. This well was drilled in 1902, and was 640 feet deep. At 585 feet an oil sand was entered which showed on test 12 barrels per day of heavy oil, but in attempting to deepen the well a string of tools was lost, and after a long fishing job the well was abandoned.

Mentey Well. In the upper reaches of Grapevine Cañon, near the north line of section 19, 3–15, a seepage of heavy oil formerly existed, and just below this a well was drilled by a Mr. Mentey in 1875. The hole was 417 feet deep, and got considerable fresh water and much gas, but no oil.

Pacoima Oil Company. In the cañon lying next east of Grapevine Cañon is an old well (northeast quarter of the southwest quarter of section 20) which is said to have been drilled by the Pacoima Oil Company. The well drilled by this company was put down in 1901 and was a dry hole at 800 feet, but the location is uncertain. Messrs. Proudfit & Parker, of Los Angeles, drilled a well somewhere in this neighborhood at this time, reported to be 800 feet deep and to have found traces of oil. This may possibly be the same well.

Wells in Placerita Cañon.

The wells in Placerita Cañon, though not commercially productive, at one time attracted great attention because of the peculiar quality of the oil, and from the very remarkable conditions under which it was found. All who had occasion to examine this territory at the time have agreed that this oil was found either in granite or in a schist of granitic appearance. As granite in its normal condition is far too dense to carry a large quantity of oil, we must understand formation to be the softened and decomposed crystalline rock sometimes found near the contact of sedimentary and plutonic formations. It is by no means easy to determine from the drillings of even a shallow well whether the tools are working in such a softened granite or in a sandstone built up from granite débris, and there is a strong possibility that this oil was actually found in sandstone. There are also the possibilities, first, that the oil might be found in granite in place, by seepage through cracks in the harder material from a nearby porous formation in which the oil was held in quantity, but if such formation exists in the neighborhood of Placerita it has not yet been located by drilling; or, second, that the oil might be brought to such a location by seepage from a considerable distance through porous shales or clays. This theory agrees well with the character of the oil, and will be spoken of in more detail in connection with the analysis of the oil.

Freeman & Nelson White Oil Company. The wells of this company were along the east line of section 4, 3–15, and just south of the New Century wells.

Well No. 1 is the farthest north, and was drilled in 1899. This well found the same white oil as the New Century well, at a depth of 520 feet. The well has never been produced commercially, except to furnish fuel for drilling rigs, but it is stated that on careful tests, extending over several days, it averages 2½ barrels per day.

Well No. 2 was drilled by Clark & Sherman of Los Angeles, in the year 1900. This well is immediately south of No. 1, and though carried to a depth of 1030 feet, was practically a dry hole, finding only slight traces of the white oil.

Well No. 3 was drilled by the Freeman & Nelson Company, but was

abandoned at 457 feet with only traces of oil. The property is now under lease to the Los Angeles & Kern Oil Mining Company.

Los Angeles & Kern Oil Mining Company. This company is drilling just east of Freeman & Nelson No. 1, and in January, 1912, had reached a depth of 450 feet.

New Century Oil Company. This company drilled four wells in the years 1900 and 1901, in the northeast quarter of section 4, 3–15, just north of Placerita Creek.

Well No. 1 was in the southeast corner of the quarter, and at 720 feet obtained a production of several barrels per day of a white limpid oil of some 43° Beaumé. The production lasted but a few days, and seems to have come from a pocket, though it is probable that the well is capable of a small steady production.

Well No. 2 of this company was located just north of No. 1, and had traces of oil at 700 feet. No. 3, one location to the north of No. 2, was carried to a depth of 900 feet without finding any oil. No. 4, still farther north, went to 1000 feet, and also had a little white oil, but not enough to pump.

San Miguel Oil & Development Company. This company drilled a well on the S. Cuneo tract, north half of the north half of section 3, 3–15, in the year 1902. This well was 1000 feet deep or thereabouts, and is said to have had traces of the white oil found in the wells farther south.

Harrison Well. This well is located on the same property as above, but about one fourth mile farther east, near the section line and just south of the county road. It was drilled in 1905, was about 2100 feet deep, and is said to have been entirely barren.

San Bernardino Well. In the 1894 report of the State Mineralogist a well under this name is reported to have been drilled in Placerita Cañon, four miles from Newhall. The hole is reported to be 640 feet deep, and abandoned because of lost tools. This well cannot now be located.

Pioneer White Oil Company. This company drilled on the northeast quarter of the southwest quarter of section 3, 3–15. The well was drilled in 1901, was 1270 feet deep, and had a very little white oil and a great deal of water, with considerable gas.

Iola Oil Company. A company by this name drilled in the year 1901 on the northeast quarter of section 12. 3–15, in Bear Cañon, a tributary of Placerita Cañon. This well is said to have been dry at a depth of 1100 feet.

Wells in Township 4–15.

At least three wells, and probably more, have been drilled in this township, but only the scantiest information can now be had.

Portland Oil Company. This company is said to have operated in the northeast quarter of section 31, 4–15, south of the divide between Placerita Cañon and Soledad Cañon, in the year 1902. This is said to have been a dry hole, about 800 feet deep.

Montezuma Oil Company. A corporation by this name is reported to have drilled in Lot 4, section 32, 4–15, but the hole cannot be located, and nothing is known as to its history.

Pacific King Oil Company. This company drilled in the northeast quarter of section 28, 4–15, south of the railroad near Humphreys station, and on the east side of a short cañon draining into Soledad Cañon. This well was 1300 feet deep, and is variously reported to have been a dry hole, and to have shown some oil near the bottom—the former appears more likely.

Wells in Township 5–15.

Newhall Consolidated Oil Company. This company drilled in the year 1902 on the southwest quarter of section 36, 5–15. This hole was taken to a total depth of 830 feet, and gave a good showing of light-brown oil at about 700 feet, estimated by the operators at from two to three barrels per day. Between 800 feet and the bottom, flowing water was struck, which could not be handled. It is said that the seepages on which this location were based lie to the east and a little north, or along the apparent strike of the main hill formation.

Tujunga Wells.

The wells of this group were drilled in townships 3–14 and 3–13, in Pacoima, Little Tujunga, and Big Tujunga cañons. This territory has never been visited by representatives of the Mining Bureau, and the reports are less definite than might be wished, but are here given.

Denver Oil Company. This company drilled in the year 1904, on the northwest quarter of section 21, 3–14, on the divide between Pacoima and little Tujunga cañons. Abandoned at 900 feet because of lost tools and flowing water. No oil.

Apex Oil Company. This company has drilled three wells, all close together, in section 22, 3–14. No. 1 was drilled in 1903, and was something over 900 feet deep. The casing was dropped and collapsed, and the hole abandoned.

Well No. 2 was drilled in 1904, and was 1564 feet deep. This hole was abandoned because of lost tools.

Well No. 3 was drilled in 1908, and was abandoned with a string of tools buried in heaving sand at 1320 feet. No. 1 was the most northerly of these three wells, all of which are in a north branch of Little Tujunga Cañon. No. 2 was farthest to the south, and No. 3 between the two, but to the east.

All these wells are said to have shown encouraging quantities of oil, but most was found at about 1200 feet in No. 3, in black shale. This oil is said to have been a light-green oil of 48° Beaumé. No producing sand was found in any of these wells, the oil being a seepage in fine, close-grained formation.

Russian Oil Company. The well of this company was drilled in 1901, on the southeast quarter of the same section, and abandoned at a depth of 1874 feet. Considerable discussion has taken place about the results from this well, some observers reporting that the well went into a hard dark granite at the bottom, and was entirely barren, while others, equally competent to judge, state that the last drillings were of a blackish shale, and that the well at times baled several gallons of a light-green oil, similar in appearance to that obtained in Apex No. 3. The discrepancy cannot now be reconciled.

Tujunga Oil Company. In the northwest quarter of section 25, 3–14, on the south side of Little Tujunga Cañon, this company drilled a shallow hole in the year 1900. This well was abandoned at 450 feet, and had a slight seepage of oil.

Boston Petroleum Company—Cañon Oil Company. A well was started by the former company in the year 1904, near the center of section 33, 3–13, on the north side of Big Tujunga Cañon. This well was suspended at a depth of 1060 feet, but was left cased and with the rig standing. In the next year the Cañon Oil Company carried the hole down to a total depth of 1170 feet, from which depth they baled several barrels of a light-colored green oil of high gravity, said to have been 37° Beaumé. This hole was drilled in very steeply-pitched formation, and was finally abandoned because of the loss of a string of tools.

Cañon Oil Company. This company drilled in 1906, after losing the preceeding well, on the same section, but a little to the east and up the cañon. This well was abandoned at 600 feet for financial reasons.

This territory is described as consisting mainly of whitish and greenish shales, some considerably indurated, and some layers of sandstone. No geological description of the country being available, it is difficult to determine whether any fair prospects exist for future discoveries. There is no question, however, that at least three of the wells, and possibly more, obtained enough oil to warrant further investigation.

RECAPITULATION.

In the ten townships which we have here taken as constituting the Newhall oil field, we have a total of 225 wells, of which 77 were producing, 141 had been abandoned, and 7 were drilling in January, 1912. As these wells produce several varieties of oil, and under widely different conditions, it may be useful to summarize briefly the results obtained in each group.

Township 4–17. An attempt was made here to extend the producing strip found north of the Santa Clara River. Three abandoned wells, with some indications of oil, no work under way at present.

Townships 5–17 and 5–16—Castaic. Three abandoned wells and one rig working in the cañon of Castaic Creek. One of the abandoned wells found some oil.

Pico Cañon. Has been producing oil since 1875. At present there are 43 producing wells, 33 abandoned, and 2 drilling. Present annual production between 90,000 and 100,000 barrels of high-grade refining oil, averaging nearly 40° Beaumé in gravity. Average daily production per well about 6 barrels.

DeWitt Cañon. Seven abandoned wells, some of which obtained some oil. No work has been done for several years.

Towsley Cañon. Twelve abandoned wells, several of which produced small quantities of oil, and one is now supplying fuel. One drilling-rig working. No production.

Wiley Cañon. Has been producing oil since about 1900. There are now 7 producing wells, 8 abandoned, and 2 drilling. Present annual production probably from 8000 to 10,000 barrels. Oil is of refining grade, but somewhat heavier than that of Pico Cañon. Average daily production per well in the neighborhood of 3½ barrels.

Rice Cañon. Ten wells have been drilled in this cañon, some of which showed oil, but all are now abandoned and no work is being done.

East Cañon. Two abandoned wells, slight indication of oil.

Leaming Cañon. Two abandoned wells, no indications of oil.

Elsmere and Newhall Cañons. In this group there are twenty-five producing wells, twenty-four abandoned, no new work being done. The present annual production is about 44,000 barrels, but could probably be increased to 60,000 barrels or more, as a number of these wells have not been worked to their capacity. The output is a heavy fuel oil, averaging about 14° Beaumé, and very similar to the heavier grades of Los Angeles City crude. Under present conditions the average daily output of these wells is about 5 barrels each.

Mud Springs Cañon. Here there are 6 abandoned wells, and 2 producing. Present annual production perhaps 5000 barrels, or about 7

barrels per day per well. This is a heavy oil, of two grades, though much lighter oil was found in some of the abandoned wells.

South Slope. On the south side of the San Fernando range seven wells have been drilled, all abandoned. Some showed small quantities of oil, but none indicated prospects for production.

Placerita. In this cañon there are twelve abandoned wells, and one rig working. Several of these wells gave a small output of white oil of some 43° gravity.

Townships 5–15 and 4–15. In these two townships four wells have been drilled, only one of which gave any direct indications of oil. All abandoned, and no work done for several years.

Tujunga. Eight wells have been drilled in this territory, several of which gave small yields of light-green oil. All are now abandoned.

QUALITY OF NEWHALL OILS.

Newhall produces many varieties of crude, ranging from the lightest to the heaviest. But one sample is available from Castaic. This is a moderately light-green oil, and as it flows from the well contains little naptha, though there is reason to believe that the quality is depreciated.

The Pico Cañon oil averages 38° Beaumé, and is an extremely volatile oil, giving high gasoline yields, much kerosene, very little asphalt and almost no lubricants. This is a very limpid greenish-black oil.

The single sample from DeWitt Cañon is a blackish oil of about 25°, giving no gasoline, and probably depreciated by exposure.

The Towsley Cañon oils are said to be of similar quality, but no samples could be had.

The oil from Wiley Cañon is about 30° Beaumé, and gives less gasoline and more asphalt than the Pico oils.

Rice Cañon is said to yield an oil similar to that of Wiley. No samples could be had.

The Elsmere oil is a thick, black, asphaltic oil, ranging from 11° to 18° Beaumé. The yield of asphalt from this oil is not large for the gravity, and the analysis is poor in all cases.

The white oil of Placerita is described in full in Chapter XX. It is water-white, very limpid, contains no gasoline nor asphalt, and appears to consist largely of aromatic hydrocarbons.

The following analyses, while some localities are not represented, probably cover the range of values very completely:

4481.†

Rose Oil Company. Castaic. Well No. 1.

Gravity ---------- 25.3° Beaumé

This is a limpid and rather pale oil, of a strong green color, with a very sweet and rather flat odor. This sample was taken from an abandoned well (the only well in this vicinity which found oil), and though the oil is flowing from a closed casing, is probably somewhat depreciated from its original condition.

†Analysis by J. P. P.

Distillation.

A sample of 100 c.c. distilled from copper, first two cuts dry, last cut in a current of inert gas. Distillation to dry coke.

First cut	15.3 per cent	43.0° Beaumé
Second cut	33.8 per cent	33.0°
Third cut	48.1 per cent	23.7°
Fixed carbon	2.8 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of inert gas, and calculation of the carbon to "D" asphalt, the following commercial analysis is had:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	17.0 per cent
Stove oil	33°	30.0 per cent
Fuel distillate	29.8°	21.6 per cent) Slop distillate
Reduced stock	13.6°	24.4 per cent) 23.7°—46.0%
Asphalt	"D"	7.0 per cent or 24.5 lbs. per bbl.
		100.0 per cent

The kerosene ran with a good color, and treated out readily to a water-white and sweet oil. The stove oil contained some hydrogen sulfid, but on treatment gave a sweet oil. The lubricating stock gave a reduced oil of a rich green and pale color, but almost solid with paraffin.

This is an interesting sample, being the only representative of the possible oils in the formation north of the river and east of the Temescal. It is very likely that as it exists in the sands, it contained some engine distillate, and possibly gasoline. On the other hand, both in appearance and in analysis it closely resembles the valueless green oils of the Ex-Mission, except for the paraffin, which is not found in these oils. The presence of this substance makes it probable that the oil is not naturally so "dead" as is shown by the analysis, but has been partly evaporated in the casing.

7468.*

Standard Oil Company. Pico No. 2.

Gravity ---------- 31.8° Beaumé (0.865 sp. gr.)

This sample was collected and analyzed in the year 1885, when this well was about ten years old. The well is said to have been 700 feet deep, but to have drawn its oil from close to the surface.

Distillation.

A sample of 500 c.c. was distilled from a copper retort, without the use of either steam or gas. Distillation was carried up to a temperature of 300° C., but the properties of the residue were not noted.

Below 150° C.	10.6 per cent	49.2° Beaumé
150 to 200°	20.6 per cent	45.0°
200 to 250°	16.2 per cent	38.1°
250 to 300°	11.3 per cent	33.1°
Residue	41.3 per cent	Not recorded
	100.0 per cent	

*Analysis by W. D. Johnston.

This is equivalent to the following partial commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	5.0 per cent
Kerosene	42°	43.0 per cent
Stove oil	33°	11.0 per cent
Residue	---	41.0 per cent
		100.0 per cent

7469.*

Standard Oil Company. Pico Cañon. H. & S. Well No. 3.

Gravity ---------- 35.5° Beaumé (0.846 sp. gr.)

This sample was collected and analyzed in the year 1886, when the well was three years old. The hole was 1550 feet deep, and drew its oil from shale under hard shells.

Distillation.

A sample of 500 c.c. was distilled from a copper retort without the use of either steam or gas. Distillation was carried up to a temperature of 500° C., but the properties of the residue were not noted.

Below 100° C.	11.2 per cent	63.6° Beaumé
100 to 125°	9.3 per cent	56.1°
125 to 150°	9.5 per cent	50.6°
150 to 200°	13.6 per cent	44.6°
200 to 250°	13.4 per cent	36.5°
250 to 300°	8.8 per cent	30.9°
Residue	34.2 per cent	Not recorded
	100.0 per cent	

These figures are closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	18.0 per cent
Engine distillate	52°	11.0 per cent
Kerosene	42°	23.0 per cent
Stove oil	33°	16.0 per cent
Residue	---	32.0 per cent
		100.0 per cent

5484.†

Standard Oil Company. Pico No. 4.

Gravity	37.3° Beaumé
Viscosity at 60° F.	1.40 Redwood
Viscosity at 185° F.	1.07 Redwood
Flash	Below 60° F., Abel-Pensky test
Sulfur	0.28 per cent by weight
Thermal value	20,054 British thermal units

*Analysis by W. D. Johnston.

†Analysis by J. P. P.

Distillation.

A sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 212° F.	10.5 per cent	57.3° Beaumé
212 to 302°	20.4 per cent	53.0°
302 to 392°	13.8 per cent	44.1°
392 to 482°	13.0 per cent	37.5°
482 to 572°	11.1 per cent	32.7°
572° to grade—a	16.9 per cent	27.9°
572° to grade—b	6.8 per cent	30.5°
Asphalt	6.8 per cent	Grade "D" (about)
Loss	0.7 per cent	
	100.0 per cent	

These figures are closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	6.0 per cent
Engine distillate	52°	29.0 per cent
Kerosene	42°	13.0 per cent
Stove oil	33°	29.0 per cent
Middlings and lubricants	28.4°	15.5 per cent (not separated)
Asphalt	"D"	6.8 per cent or 23.9 lbs. per bbl.
Loss	---	0.7 per cent
		100.0 per cent

7471.*

Standard Oil Company. Pico No. 9.

Gravity ---------- 37.5° Beaumé (0.836 sp. gr.)

This sample was collected and analyzed in the year 1886, when this well was four years old. This hole was then producing thirty-five barrels daily from the bottom of the hole, 1550 feet, but has since been abandoned.

Distillation.

A sample of 500 c.c. was distilled from a copper retort without the use of steam or gas. Distillation was carried to 500° C., but the properties of the residue were not noted.

Below 100° C.	13.1 per cent	67.1° Beaumé
100 to 125°	6.5 per cent	58.4°
125 to 150°	10.0 per cent	53.2°
150 to 200°	13.6 per cent	46.3°
200 to 250°	12.4 per cent	38.9°
250 to 300°	7.2 per cent	33.5°
Residue	37.2 per cent	Not recorded
	100.0 per cent	

This is closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	28.0 per cent
Engine distillate	52°	2.0 per cent
Kerosene	42°	27.0 per cent
Stove oil	33°	6.0 per cent
Residue	---	37.0 per cent
		100.0 per cent

*Analysis by W. D. Johnston.

7472.*

Standard Oil Company. Pico No. 13.

Gravity ---------- 38.3° Beaumé (0.832 sp. gr.)

This sample was collected and analyzed in the year 1886, when this well was three years old. This was the hole which was known as the "paraffin well," as much solid paraffin separated from the oil, and collected on the sucker rods and in the tubing. In this year it was producing forty barrels per day from a depth of 1600 feet.

Distillation.

A sample of 500 c.c. was distilled from a copper retort without the use of steam or gas. Distillation was carried to 300° C., but the properties of the residue were not recorded.

Below 100° C.	9.7 per cent	66.3° Beaumé
100 to 125°	8.8 per cent	58.7°
125 to 150°	6.0 per cent	54.0°
150 to 200°	12.0 per cent	48.8°
200 to 250°	11.2 per cent	42.4°
250 to 300°	13.0 per cent	36.6°
Residue	39.3 per cent	Not recorded
	100.0 per cent	

This is equivalent to the following commercial analysis:

Gasoline	61° Beaumé	23.0 per cent
Engine distillate	52°	2.0 per cent
Kerosene	42°	36.0 per cent
Stove oil	33°	None
Residue	---	39.0 per cent
		100.0 per cent

7444.†

Standard Oil Company. Pico Cañon Wells. Average sample.

Gravity ---------- 38.5° Beaumé

This is a very limpid and light-colored, brownish oil, with a sweet, fragrant odor.

Distillation.

A sample of 150 c.c., distilled from copper without steam or gas. Distillation carried to dry coke. Little or no decomposition of the crude in distillation, except at the very last end.

First cut	19.1 per cent	59.4° Beaumé
Second cut	22.9 per cent	47.7°
Third cut	34.8 per cent	34.3°
Fourth cut	20.1 per cent	31.1°
Fixed carbon	3.1 grams per 100 c.c.	
	100.0 per cent	

*Analysis by W. D. Johnston.

†Analysis by H. N. Cooper.

There was no lubricating stock from this crude, which runs entirely to light products and middlings. On calculation the following commercial analysis is shown:

Gasoline	61° Beaumé	15.0 per cent
Engine distillate	52°	13.5 per cent
Kerosene	42°	18.0 per cent
Stove oil	33°	30.5 per cent
Fuel distillate	31°	15.2 per cent
Asphalt	"D"	7.8 per cent or 27.4 lbs. per bbl.
		100.0 per cent

The light products were extremely sweet, and came from the still almost water white. This is a peculiarly clean and refinable oil, though a characteristic "asphalt base" oil, and almost free from paraffin.

Several of the succeeding analyses are much more accurate in the separation of the light products.

7473.*

Standard Oil Company. Pico Cañon. San Fernando No. 1.

Gravity ..... 38.6° Beaumé (0.830 sp. gr.)

This sample was collected and analyzed in the year 1886, when this well was four years old. The hole was then doing twenty barrels per day, from a depth of 1176 feet.

Distillation.

A sample of 500 c.c. was distilled from a copper retort, using neither steam nor gas. Distillation was carried to 300° C., but the properties of the residue were not noted.

Below 100° C.	17.3 per cent	64.4° Beaumé
100 to 125°	11.0 per cent	55.9°
125 to 150°	9.4 per cent	50.4°
150 to 200°	13.3 per cent	44.3°
200 to 250°	10.6 per cent	36.9°
250 to 300°	6.8 per cent	31.8°
Residue	31.6 per cent	Not recorded
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	28.0 per cent
Engine distillate	52°	5.0 per cent
Kerosene	42°	28.0 per cent
Stove oil	33°	5.0 per cent
Residue		34.0 per cent
		100.0 per cent

*Analysis by W. D. Johnston.

7470.*

Standard Oil Company. Pico No. 4.

Gravity ---------- 39.7° Beaumé (0.825 sp. gr.)

This sample was collected and analyzed in the year 1886, when this well was ten years old. It was then doing thirty barrels per day at 1,000 feet, but has since been deepened.

Distillation.

A sample of 500 c.c. was distilled from a copper retort without the use of either steam or gas. The distillation was carried to 300° C., but the properties of the residue were not noted.

Below 100° C.	9.1 per cent	69.4° Beaumé
100 to 125°	10.4 per cent	59.4°
125 to 150°	9.3 per cent	53.7°
150 to 200°	13.4 per cent	47.9°
200 to 250°	13.9 per cent	40.9°
250 to 300°	8 3 per cent	35.3°
Residue	35.6 per cent	Not recorded
	100.0 per cent	

These figures are closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	28.0 per cent
Engine distillate	52°	1.0 per cent
Kerosene	42°	36.0 per cent
Stove oil	33°	None
Residue	---	35.0 per cent
		100.0 per cent

7474.*

Standard Oil Company. DeWitt Cañon. H. & S. No. 1.

Gravity ---------- 23.8° Beaumé (0.910 sp. gr.)

This sample was collected and analyzed in the year 1886, when this hole had been drilled and abandoned about four years. It was then, as now, flowing slowly, from a depth of about 1,000 feet.

Distillation.

A sample of 500 c.c. was distilled from a copper retort, using neither steam nor gas. Distillation was carried to 300° C., but the properties of the residue were not recorded.

Below 150° C.	6.6 per cent	54.9° Beaumé
150 to 200°	11.2 per cent	47.9°
200 to 250°	7.0 per cent	40.5°
250 to 300°	8.8 per cent	35.5°
Residue	66.4 per cent	Not recorded
	100.0 per cent	

This is equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	14.0 per cent
Kerosene	42°	11.0 per cent
Stove oil	33°	10.0 per cent
Residue	---	65.0 per cent
		100.0 per cent

*Analysis by W. D. Johnston.

7446.*

Standard Oil Company. Wiley No. 6.

Gravity	29.9° Beaumé
Viscosity at 60° F.	2.21 Redwood
Viscosity at 185° F.	1.22 Redwood

Distillation.

Sample of 200 c.c., distilled from glass flask without steam or gas.

Below 212° F.	2.9 per cent	61.8° Beaumé
212 to 302°	17.4 per cent	50.6°
302 to 392°	10.3 per cent	42.3°
392 to 482°	10.3 per cent	36.5°
482 to 572°	13.5 per cent	31.6°
572 to grade—a	20.8 per cent	28.2°
572 to grade—b	9.5 per cent	26.8°
Asphalt	10.9 per cent	Grade "D" (about)
Loss	4.4 per cent	
	100.0 per cent	

These figures are closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	3.8 per cent
Engine distillate	52°	13.3 per cent
Kerosene	42°	19.3 per cent
Stove oil	30.4°	20.4 per cent
Middlings and lubricants	27.7°	31.8 per cent (not separated)
Asphalt	"D"	11.4 per cent, or 40 lb. per bbl.
		100.0 per cent

7440.*

Santa Ana Oil Company. Newhall Cañon. Well No. 2.

Gravity	11.7° Beaumé
Viscosity at 185° F.	4.75 Redwood
Sulfur	0.69 per cent by weight
Calorific value	18,481 British thermal units

Distillation.

Sample of 200 c.c., distilled from a glass still without steam or gas.

Below 482° F.	12.8 per cent	34.5° Beaumé
482 to 572°	16.8 per cent	26.1°
572° to grade—a	37.0 per cent	24.0°
572° to grade—b	6.7 per cent	27.1°
Asphalt	22.6 per cent	Grade "D" (?)
Loss	4.1 per cent	
	100.0 per cent	

These figures are roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	15.0 per cent (about)
Middlings and lubricants	24.9°	60.4 per cent, not separated
Asphalt	"D" (?)	24.6 per cent, or 86.4 lbs. per bbl.
		100.0 per cent

This oil has no refining value except for the manufacture of asphalt. It is probable that the asphalt percentage stated is too low.

*Analysis by H. N. Cooper.

7442.*

Standard Oil Company. Elsmere Cañon. A well.

Gravity	14.5° Beaumé
Viscosity at 185° F.	4.75 Redwood
Sulfur	0.72 per cent by weight
Thermal value	18,662 British thermal units

Distillation.

A sample of 200 c.c., distilled from glass still, without steam or gas.

Below 482° F.	11.5 per cent	33.5° Beaumé
482 to 572°	12.2 per cent	26.1°
572° to grade—a	36.5 per cent	23.2°
572° to grade—b	6.8 per cent	25.4°
Asphalt	28.3 per cent	Grade "D" (about)
Water and loss	4.7 per cent	
	100.0 per cent	

These figures are closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	13.0 per cent
Middlings and lubricants	24.1°	57.7 per cent, not separated
Asphalt	"D"	29.3 per cent, or 102.8 lbs. per bbl.
		100.0 per cent

7445.*

Standard Oil Company. Elsmere No. 2.

Gravity	14.8° Beaumé
Viscosity at 185° F.	4.13 Redwood
Sulfur	0.62 per cent by weight
Thermal value	18,700 British thermal units

Distillation.

A sample of 200 c.c., distilled from a glass flask, without the use of steam or gas.

Below 392° F.	12.5 per cent	34.5° Beaumé
482 to 572°	24.7 per cent	26.1°
572° to grade—a	34.9 per cent	24.0°
572° to grade—b	2.7 per cent	27.1°
Asphalt	24.5 per cent	Grade "D" (about)
Loss	0.7 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	15.0 per cent
Middlings and lubricants	24.9°	59.8 per cent, not separated
Asphalt	"D"	24.5 per cent
Loss	---	0.7 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

6463.*

Zenith Oil Company. Well No. 4.

Gravity ---------- 16.2° Beaumé

This is a moderately heavy blackish oil, with a mild odor.

Distillation.

Sample of 300 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to a residue of dry coke.

First cut	7.4 per cent	42.0° Beaumé
Second cut	7.4 per cent	32.8°
Third cut	77.4 per cent	19.0°
Fixed carbon	7.8 grams per 100 c.c.	
	100.0 per cent	

On the reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	7.4 per cent
Stove oil	33°	7.4 per cent
Fuel distillate	29.6°	22.4 per cent / Slop distillate
Reduced stock	15.2°	43.3 per cent \ 10.0°—65.7%
Asphalt	"D"	19.5 per cent, or 68.6 lbs. per bbl.
		100.0 per cent

The kerosene from this oil ran yellow, with a mild color, but treated out to a very mild and sweet water-white oil. The stove oil also took treatment well, and was pale and sweet.

The lubricating stock was only of medium viscosity, and the reduced stock rather thin but of good color and fair outer tone, and free from paraffin.

4412.†

Pearl Oil Company. Newhall Cañon. Well No. 1.

Gravity ---------- 17.2° Beaumé

This is a fairly limpid, brownish-black oil, of the odor characteristic of San Joaquin Valley crude oils.

Distillation.

Sample of 100 c.c., distilled from glass, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are:

Below 302° F.	21.9 per cent	36.9° Beaumé
302 to 518°	33.1 per cent	25.5°
Residue	45.6 per cent	Liquid asphalt, semi-solid
	100.6 per cent	

*Analysis by J. P. P.

†Analysis by J. P. P.

After evaporation to asphalt, and calculation, these figures are very roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	10.0 per cent
Stove oil	33°	12.0 per cent
Middlings and lubricants	---	55.1 per cent, not separated
Asphalt	"D"	22.9 per cent, or 80.4 lbs. per bbl.
		100.0 per cent

In this connection see a large scale analysis of Zenith crude in Chapter XXII. The low temperature at which the first fraction of 37° Beaumé came over is remarkable.

7441.*

Pearl Oil Company. Well No. 2.

Gravity	17.8° Beaumé
Viscosity at 60° F.	48.37 Redwood
Viscosity at 185° F.	4.75 Redwood
Flash point	96° F., Abel-Pensky test
Sulfur	0.49 per cent by weight
Thermal value	18,830 British thermal units

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 302° F.	1.2 per cent	49.7° Beaumé
302 to 392°	8.0 per cent	41.4°
392 to 482°	11.2 per cent	32.4°
482 to 572°	21.0 per cent	25.8°
572° to grade—a	24.0 per cent	21.4°
572° to grade—b	10.8 per cent	24.1°
Asphalt	22.7 per cent	Grade "D" (about)
Loss	1.1 per cent	
	100.0 per cent	

These figures are closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	9.5 per cent
Stove oil	33°	10.0 per cent
Middlings and lubricants	23.7°	56.7 per cent, not separated
Asphalt	"D"	22.7 per cent, or 79.1 lbs. per bbl.
Loss	--	1.1 per cent
		100.0 per cent

2462.†

D. A. Connell. Mud Springs Cañon. Lease Average.

Gravity	17.2° Beaumé

This is a rather thick, brown-black oil, with a slight greenish tint and a sweet odor.

*Analysis by H. N. Cooper.

†Analysis by P. W. P.

Distillation.

A sample of 100 c.c., distilled from copper in a current of inert gas. Distillation carried to dryness.

First cut	21.6 per cent	30.9° Beaumé
Second cut	72.0 per cent	19.8°
Fixed carbon	6.4 grams per 100 c.c.	

100.0 per cent

On reduction of the second cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	16.0 per cent
Fuel distillate	24.9°	24.5 per cent / Slop distillate
Reduced stock	Solid	43.5 per cent \ 19.8°—68.0%
Asphalt	"D"	16.0 per cent, or 56.2 lbs. per bbl.

100.0 per cent

On distillation on a larger scale this oil would probably show a little kerosene but not enough to be of value. The heavy end of the oil is unsuited to the manufacture of ordinary lubricants because of the large amount of paraffin.

5483.*

Standard Oil Company. Elsmere Cañon. A well.

Gravity ..... 18.1° Beaumé

This is a moderately thick, brownish-black oil, with a sweet and rather sulfurous odor.

Distillation.

Sample of 100 c.c., distilled from copper in a current of gas. Distillation carried to dryness.

First cut	15.0 per cent	30.5° Beaumé
Second cut	75.8 per cent	14.5°
Fixed carbon	9.2 grams per 100 c.c.	

100.0 per cent

On reduction of the lubricating stock in a stream of gas, and calculation of the fixed carbon to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	11.0 per cent
Fuel distillate	30.5°	19.1 per cent / Slop distillate
Reduced stock	14.5°	46.9 per cent \ 20.4°—66.0%
Asphalt	"D"	23.0 per cent, or 70.7 lbs. per bbl.

100.0 per cent

*Analysis by J. P. P.

In spite of the very low gravity of the reduced stock from this oil it has but little viscosity, and is bluish and of a dark color. This crude appears to have no refining possibilities whatever.

5489.*

Nettleton & Kellerman Oil Company. Mud Springs Cañon. Well No. 2.

Gravity ---------- 30.6° Beaumé

This is a very limpid and light-colored oil, with a strong green tone, and having a mild and sweet odor. This well found two grades of oil, the lighter being beneath. This sample was obtained from the inner casing, in which the oil rises almost to the surface, and the oil as obtained has probably lost some gasoline.

Distillation.

A sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	18.6 per cent	52.1° Beaumé
Second cut	9.1 per cent	42.8°
Third cut	29.6 per cent	30.0°
Fourth cut	39.5 per cent	23.1°
Fixed carbon	3.2 grams per 100 c.c.	
	100.0 per cent	

On calculation of the coke to asphalt, and reduction of the last cut in a current of gas, the following commercial analysis is had:

Gasoline	61° Beaumé	None
Engine distillate	52°	18.6 per cent
Kerosene	42°	10.0 per cent
Stove oil	33°	22.0 per cent
Fuel distillate	30.7°	16.6 per cent) Slop distillate
Reduced stock	Solid	24.8 per cent) 23.1°—41.4%
Asphalt	"D"	8.0 per cent, or 28.1 lbs. per bbl.
		100.0 per cent

The light products from this oil were of the best quality, white and sweet, and needed little treatment. The last end of the lubricating stock ran solid from the still, as did also the end of the fuel distillate, on reduction. The reduced stock was hard and crystalline, not pasty as is usually the case with stocks containing paraffin.

This oil comes very close to being a "paraffin base" oil, and in this respect differs notably from most, at least, of the very similar appearing oils of Pico Cañon.

*Analysis by P. W. P.

CHAPTER XI.

LOS ANGELES CITY FIELD.

The oil field of Los Angeles City was discovered eight years previous to the opening of the Kern River field, and is still producing profitable quantities of oil. Because of its very limited area, the output of this field was never of the first importance, but its effect on the industry as a whole is measured by the large number of persons directly engaged in oil production, and by the attention attracted by the peculiar location of the field, rather than the value of its production.

The output of the City field has greatly declined, as is but natural considering its age, and the number of wells in operation has much diminished. In all, some 1300 wells appear to have been drilled in this very limited area, of which the larger part, at least 1100, have been at one time productive. Of this number but 393 are now producing, so that while the average output per well is lessening but slowly, the total output is greatly decreased.

The large number of wells crowded into this narrow field, and the relatively small importance of each as a producer, makes it inadvisable to handle this field in the manner elswhere adopted in this work. The following remarks will therefore be confined to a brief résumé of the history and geology of the field, taken mainly from older works.

Topography.

The city of Los Angeles is situated at the northern apex of a plain, bounded at the north and northwest by the Santa Monica Mountains, and on the northeast by the Puente hills. The Los Angeles River enters this plain at the north, and flows due south to the ocean, while San Gabriel River enters at the northeast and takes a parallel course at a very short distance.

West of the mouths of these rivers lie two ranges of high hills, the San Pedro and Redondo ranges, both parallel and closely adjacent to the coast. Between these ranges and the Santa Monica Mountains the Los Angeles plain reaches to the coast, which here bends to the north. The drainage of this plain is thus in two directions—to the south and southeast through Los Angeles River, and to the west through Ballona Creek and smaller watercourses. The watershed is along a line ranging northeast from a point near Westlake Park, and thus falls nearly in the center of that portion of the city lying west of the river.

The northern portion of the city of Los Angeles, and that portion in which the oil measures were found, is situated on a rolling table-land slightly over two hundred feet above sea-level, and immediately at the foot of a minor range of hills which juts out in a southeasterly direction

from the end of the Santa Monica range. West of Vermont avenue the plain slopes gently away to the ocean at Santa Monica, being interrupted only by the low and rolling Beverly hills. East of Vermont avenue the ground is rougher, consisting of the rounded spurs of the Elysian Park hills, the tendency of the ravines here is toward the south, and the level plain is nowhere distant more than a few blocks from the line of wells.

The Elysian Park hills, so called from the park in which they occur, are cut through by the Los Angeles River, but reappear on the east side, in that portion of the city known as Boyle Heights. Still farther to the east San Gabriel River cuts through the hill range, which to the east of this river is known as the Puente Range. Though interrupted by the narrow and plainly eroded valleys of these two rivers, the Elysian Park and Rapetto hills are but a continuation of the Puente hills, and though apparently broken by local irregularities of formation, the Los Angeles oil fields are, in the broader sense, a continuation of the Whittier and Fullerton fields.

The most westerly group of wells on the Los Angeles plain is located in the Beverly hills, from which it takes its name. Farther to the east, and south of the town of Sherman, lie the Salt Lake wells, covering an area some three miles east and west by about one mile north and south. These two groups are usually considered as one field, under the name "Salt Lake," or "Sherman" field.

Northeast of the Salt Lake wells, and due south of Colegrove Station, a small group of wells was drilled, which belong properly to the Salt Lake group, as they drew their oil from the same sands. These wells are now entirely abandoned. Due south of the Salt Lake wells, in a parallel formation, much prospecting has been done and some oil discovered, but there is no production at present. Both these groups will be considered in connection with the Salt Lake field.

East of the wells, just mentioned as south of Colegrove, and occupying a space of about one square mile, with its center at Western avenue and Temple streets, was another group of ninety-eight wells, all now abandoned. These wells belong properly to the City field rather than to Salt Lake, and will be considered under the name "Western Avenue Wells."

Between Rosedale avenue (now Westmoreland street) and Coronado street, there was formerly a large and compact group of wells, now almost entirely abandoned. This group was terminated by a fault zone, extending across the producing strip at its east end, and had its main axis northwest by southwest. These wells will be considered under the name "West Field."

East of Coronado street, and extending to the Sister's Hospital on Sunset boulevard, a narrow strip of producing territory was found.

This was terminated at both ends by cross faults. It had an east and west axis, and dipped sharply to the south. The eastern end of this strip is now exhausted and abandoned, but the central and western portions are still producing. This strip was known originally as the Second Street Park field, later as the Central field or Old field.

East of Sunset boulevard, another strip along the same axis was developed, and proved up almost to Los Angeles River, where it terminated in another cross fault. The axis of this strip bore somewhat north of east, and the sands dipped mainly to the south. Most of the wells in this strip are yet producing. This is known as the East field.

East of the river considerable prospecting was done over Boyle Heights and oil obtained in several wells, but no production was had. A single prospect well is now being drilled in this formation, but east of the city limits, and in territory elsewhere described under the head "Rapetto Hills." A number of prospect wells were also drilled both north and south of the City field, and some of these found oil, but no paying quantities were discovered.

These various divisions of the Los Angeles field will be briefly described in their order, starting from the east.

East Los Angeles.

There are known to have been at least fifteen wells drilled for oil east of the river, and west of the present city limits, but only scattering records of these operations remain, and it is probable that there were others which can not now be located. The history of these wells, so far as it can be found, is taken mainly from Bulletins 11 and 19 of the State Mining Bureau, by W. L. Watts.

Bland well. Drilled by F. E. Bland, on Judson street, between State and Lord streets. Oil is said to have been struck in an 80-foot water well.

Boyle Heights wells. Not exactly located, but probably somewhere in the neighborhood of the Brook well. Reported to have been 300 feet and 600 feet deep, respectively, and to have had a showing of oil, with much water.

Brook or Chandler well. Drilled in 1894, at the corner of Magnolia and Breed streets. Watts reports "sandy shale and clay with oil to 100 feet, bluish mud to 324 feet, large quantities of salt water at 335 feet; a good showing of oil under a hard shell at 150 feet."

DeSoto Oil Company well. Drilled in 1898, on Harrison street near Tremont. Clay shale to 700 feet; no oil.

Far East Oil Company well. North of Wabash street, and just west of the city limits. This well was drilled to a depth of 930 feet, and found a sand with water and traces of oil between 540 and 590 feet, but no indications below.

Gasson well. Not located, said to have been on the Hunter tract, west of Garvanza. Depth, 985 feet; water but no oil.

Headley well. Not located, said to have been a short distance north of Reservoir No. 5, depth, 840 feet; without any oil.

Hoag & Silent well. A well was drilled with a standard rig near Wabash and San Benito street, but no record can be found.

Johnson well. Oil is said to have been struck in a 40-foot water well at State and Bailey streets.

Rees well. Corner Brittania and Sheridan streets. Said to have had shale with some oil from 403 feet to 800 feet. Total depth, 825 feet; casing pinched.

Scott & Loftus No. 1. On St. Louis street, between Emerson and Scott streets. This was the only actually productive well drilled east of the river. At 560 feet it passed through a 5-foot sand which proved on pumping to be good for seven barrels per day of 17° oil. Below this, sandy shale to 800 feet, sand and water to 875 feet. The water broke into this well through trouble with the casing, and it was abandoned after a short time.

Scott & Loftus No. 2. This well was on Soto street, east of Magnolia. Total depth, 803 feet, with much water but only traces of oil.

Wilkinson well. Not located, but said to have been a quarter mile east of Reservoir No. 5. Depth, 670 feet; said to have shown traces of oil at 640 feet.

Rapid Transit well. A well on the line of the Rapid Transit Railroad, a short distance east of Mission road and north of Bridge street, is said to have had some oil at about 400 feet. At 640 feet a large quantity of water was struck, which drowned the well.

While all these wells are shallow, they indicate a broken condition of the formation, and the meeting of large quantities of water so close to the surface is not encouraging. No prospecting has now been done on this side of the city for a long time, and the increase in real estate values in the more easterly portion of this area has been such that none is likely to be attempted in the future.

East Field.

The first well in the group known as the East field was drilled by the Maier & Zobelein Brewing Company, at the corner of Adobe and College streets, in November, 1896. This well being an excellent producer, the field was drilled up very rapidly, and by the end of 1897, two hundred or more wells had been sunk.

In June, 1900, Watts reports 239 wells east of Sunset boulevard and west of Buena Vista (North Broadway), of which 150 were productive, and 89 shut down or abandoned. The price of oil locally was at this

time extremely low, which probably accounts for the large number of wells shut down. In April, 1903, the records of the Oil Inspector, Charles A. Blackmar, showed 291 wells, of which 272 were producing and 19 abandoned.

In February, 1906, Ralph Arnold reports a total of 270 wells, of which 211 were productive and 59 abandoned. In February, 1912, a count showed a total of 300 wells in this division, of which 223 were productive and 77 abandoned.

The formation from which the oil of the East field is drawn appears to consist of a monocline (or, of one limb of an anticline faulted along its apex) dipping to the south. At both ends, to the west at about Sunset boulevard and to the east along the line of the Catholic cemetery, this formation is badly broken, and wells drilled in this broken ground, while usually finding some oil, get too much water to be profitable.

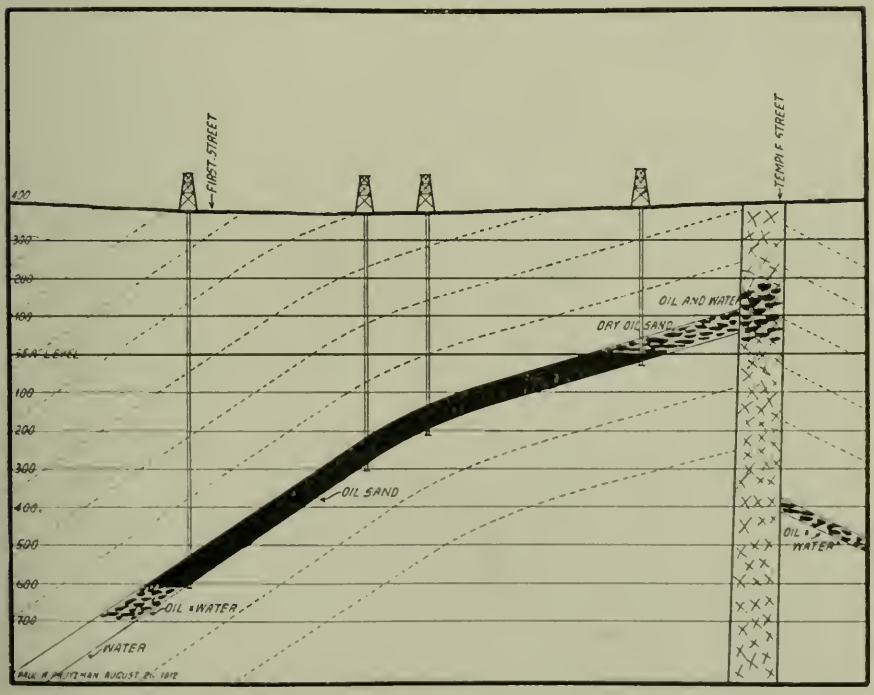


FIGURE 27.
Cross section, East Field, Los Angeles City.

At its upper edge this south-dipping formation is bounded by the east-west fault along the apex of the anticline, the productive sands nowhere coming closer to the surface than some 600 feet. The angle of dip varies in different parts of the strip. To the west it appears to be

some 35 degrees, and almost due south, but at the eastern end the dip is quite irregular, the eastern extremity dipping to the east at angles running up to 50 degrees. The southern limit of the strip is determined by water level, the wells farthest down the dip finding water in sands which farther up produce oil. The variations in the width of the producing strip appear to be due entirely to lack of parallelism between the fault forming the upper margin and the line at which water is struck, and this lack of parallelism is again due to the varying dip of the strata rather than to variations in water level at different points.

The oils of this group were produced from two sands. The upper varies from 50 feet thickness at the western end of the strip to about 200 feet at the eastern end. Below this comes a layer of clay-shale, varying from 35 feet at the west end to 105 feet at the east, and then a second oil sand, said to be 25 feet thick at the west end of the field, and nearly 100 feet at the eastern end. The depth from the surface to the first sand varies from 400 to 700 feet in different parts of the field, being greatest at the south, and the total depth of wells ranges from 500 to upwards of 1500 feet.

The upper sand is said to have produced a rather light oil, from 18° to 19° Beaumé, while that from the lower sand was originally about 16° Beaumé. None of the lighter oil is now in evidence, and it is said that this sand was rapidly exhausted. The average gravity from the lower sand in this part of the field is now well below 16°, in fact 15° Beaumé (corrected for water) would be nearer the average of the output. These wells produce a great deal of water, the larger part of which is free. Some sands produce red (emulsified) oil, but this also settles clear on steaming, which is not objectionable to an oil of this gravity. The analysis of a typical sample from this portion of the field is given in a later chapter.

The sands of the East field are much less open than those of the central and western divisions, and these wells were often spoken of as "mud-holes." Nevertheless, their production has held up in a remarkable manner. A few of these wells started off at high figures, up to sixty barrels per day, it is said, but these soon fell off, which is natural considering the extent to which they were crowded, and at the end of 1899 the production per well per day was not over six barrels, and probably less than this. At this time the average age of these wells was not over two years. At present, the average age being not far from thirteen years, the production per well per day approximates three barrels, so that it appears likely that, if not crowded out by an increase in real estate values (which in this portion of the city does not appear imminent) or by too rigorous municipal restrictions, these wells will continue to produce at a profit for many years to come.

Soledad Cañon, Los Angeles County.

A Portion of East Field, Los Angeles City.

As to the abandoned wells in this portion of the field, a few only were originally failures, but profiting by the experience of the Central field, and noting the appearance of small quantities of water as wells worked down the dip, an unusually small number of barren holes were required to clearly show the limits of the productive sands. Such wells as have since been abandoned appear to have been allowed to go for mechanical rather than other reasons. In other words, the small production per well, and the excessive number of wells crowded into this limited area, made it unprofitable to put extensive repairs on a well in any way damaged. While this field undoubtedly produces more water now than when first drilled in, it does not appear that water has encroached on the sands to any alarming extent, nor that any great number of wells have been abandoned from this cause.

These wells are, with one exception, pumped entirely on jacks, usually about eight wells to a power. A single well on the west line of Adobe street, south of Bernardo, is pumped on the beam, as contrary to the rule in this field it sands badly. The city authorities discourage the use of drilling tools, and such cleaning as is required is done with a mud-scow.

Central or Old Field.

The original discovery of oil in the City field proper was made at the corner of Patton and Colton streets, though the Maltman and Ruhland wells, in the western end, had been producing at intervals for some years. In 1892 Messrs. Doheny and Connon dug a shaft at this location to a depth of 155 feet, and striking some seepages, and too much gas to permit of continued digging, bored an 18-inch hole in the bottom of the shaft. This hole produced several barrels per day for some time, and on the strength of this showing the same parties moved across Colton street, to a location in what was then known as Second Street Park, and drilled a producing well. This portion of the city was already laid out in town lots and partially built up, and as each lot owner figured himself a prospective oil magnate, a boom in drilling resulted which has probably not since been equaled, even in the palmy days of Midway. At the end of the year 1895, three hundred and eight producing wells are reported from this division of the field, in addition to which there must have been a number of failures, no record of which can now be found.

In June, 1900, Watts reports 338 producers in this field, most of the new wells (later than 1895) having been at the western extension, north of Ocean View avenue and between Bonnie Brae and Alvarado streets. Again the number of abandoned wells is not given. In April, 1903, Blackmar's report gives a total of 537 wells in the Central field, of which 457 were producing and 80 abandoned.

In February, 1906, Arnold reports 516 wells in this field, of which

206 were producing and 310 abandoned. This total, it will be noted, is less than is given three years previous, when a slight amount of drilling was yet in progress, but as the count of producing wells can not be questioned, it may be assumed that some of the older abandoned wells had entirely disappeared at this time. In February, 1912, a count showed a total of 522 wells, of which 170 were producing, and 352 abandoned.

The formation from which the oil of the Central field is drawn is similar to that of the Eastern field, but somewhat more regular. It appears to be a monocline, dipping to the south at an angle of about 40 degrees. On the north, production is bounded by a fault zone, in which some oil was found, but also much water. At the south, the limit of production was that line along which water takes the place of the oil beneath which it lies. The width of the producing strip, as in the East field, is determined by the varying inclination of the producing sands, but also, and in this unlike the East field, by differences in the absolute height of water level at different locations.

At the east the development of this strip carried the wells into broken ground, in which profitable quantities of oil were found, but at a slight depth and with much water. These wells very soon failed and were the first to be abandoned. But few wells now remain in operation east of Lakeshore boulevard, and most of those once pumped between this street and Sunset boulevard appear to have been abandoned because of water.

To the west, badly broken ground was found west of Quebec street, and drilling was very difficult. But in spite of bad drilling and much water, these wells, which are considerably deeper than most of the wells in this field, were the best producers in the group, and most of them are still in operation.

The depth of wells in this group ranges from 475 feet to 1300 feet or more. Two producing sands were found in this field also, and these seem to be practically identical with those of the East field. The upper sand was as a rule about 125 feet thick, but only a few feet at the bottom of this layer were productive. The oil from this sand sometimes went as high as 20° Beaumé. The second sand lay about 200 feet below, and was usually about 45 feet thick. This sand produced an oil ranging from 13.5° to 16° Beaumé, and was far richer than the upper sand. Below this stratum, water was found, and on going down the dip, water would finally be found in the lower sand while the upper yet contained oil; in other words, the water level appeared to be at least approximately a plane.

At present most of the wells in this field produce much water, probably about as much as those of the East field. This water separates freely on heating, and with the lighter oils on tanking, and red or emul-

sified oils are rare. The average gravity of the oil from this field is now about 15° Beaumé. A typical analysis is given in a later chapter.

In the year 1895, the average production from 308 wells was 6.5 barrels per day per well. In 1899, when the average age of wells was approximately six years, the average daily production per well is given as 3.7 barrels. During 1911, when the average age of these wells had reached some eighteen years, the average daily production per well was approximately three barrels. It should be noted, however, that the less profitable wells at the east end of the strip had been abandoned in considerable numbers, and there is little doubt that the original production of the wells which now remain was greater than the average above given. As these wells are mainly located in the best residence district in the older part of the city, it is not likely that they will be pumped very much longer.

These wells never made any sand to speak of, and are all pumped on the jack. On account of the restrictions placed on cleaning operations, many of these holes are now in very bad condition, and in many cases the depth is notably less than when first drilled.

West Field.

Differing from the divisions already mentioned, where but one small brea deposit indicated the presence of oil, the West field showed a number of seepages. At one of these, lying a short distance west of Coronado and south of First street, a well was dug as early as 1857, known as the Dryden well, from which considerable quantities of heavy oil were baled and sold. In later years, probably somewhere about 1890, a group of nine wells was sunk on the Maltman tract, a short distance north of the Baptist College, and a group of twelve on the Ruhland tract, a couple of blocks to the west of Westlake Park. A number of prospect wells were drilled at various times, but without success other than at these two locations, and the production from these wells was too small to encourage further developments, so that no real production of oil was had at this end of the City field until after both the central and the eastern divisions had been drilled up.

About the year 1899 drilling was carried west of the strip of broken formation encountered near Coronado street, and oil found at a much less depth. Developments, as in the eastern divisions, proceeded rapidly, and in June, 1900, Watts reports 175 producing wells located between Coronado street and Vermont avenue, and also mentions a dozen or fifteen located west of the latter street, though there are probably others not mentioned. No count of the abandoned wells is given.

The count made in April, 1903, stopped at the city limits, and so includes no wells west of Vermont avenue, but between Vermont and Coronado there were 331 wells, of which 268 were productive and 63

abandoned. An examination of the notes made at the time discloses that some portions of this area were already beginning to fall below the line of profitable production.

In February, 1906, Arnold's map of the field shows a total of 344 wells between Rosedale avenue (now Westmoreland) and Coronado street. Of these 75 were producing and 269 abandoned. As 33 of these wells are shown lying west of Vermont, the total between Vermont and Coronado is but 311, and it is evident that some of the abandoned wells noted in 1903 had completely disappeared.

In the current year (January, 1912) this territory was visited, but except for one group of 21 wells at Geneva and Commonwealth streets, this entire area west of Coronado street had been abandoned, and but few traces now remain of the former presence of oil wells.

The eastern boundary of this field was formed by the fault zone at Coronado street. West of this strip, the oil sands were found to be dipping south by a little west, and at a slight angle. Watts reports that just east of Occidental boulevard, the wells farthest south went 525 feet to the sand, and penetrated it for 60 to 80 feet, while those farthest north encountered the sand at some 200 feet, and found it but slightly over 20 feet thick. At the corner of Fourth and Hoover streets a well was drilled to a total depth of 1430 feet, finding productive sands at 250 feet, 1100 feet and 1300 feet. This well, however, found so much water at depth that its production was slight. (Arnold, Bulletin 309.) North of Third street and east of Juanita the old Maltman wells found the sand at from 140 to 285 feet, and southwest of these wells an upper sand crops, which is still seeping a little oil. The wells just west of Vermont avenue found the sand at depths ranging from 300 to 400 feet, while a well at Vermont and First streets found several sands down to depths of 1735 feet, but much more water than oil. At the southwest limit of this group drilling was terminated by reaching water level, which seems to have been about 1000 feet below the surface originally. Further down the dip no oil was found, but water only. It appears likely that there was also a fault along the southern margin, and that the Ruhland wells, which were drilled in a brea bed and were all less than 100 feet deep, were either in fault material or in another formation.

The oil sands of this group appear to have been generally from 20 to 100 feet thick, but did not carry nearly so much oil as those farther east. The oil also was heavier, much of it being as low as 12° Beaumé, and considerable of it was emulsified, even when the wells were new.

This field appears to have failed by reason of entrance of water from the lower side, from which side it followed up the oil as it was withdrawn. The upper wells, however, seem to have failed by simple exhaustion of the sands which, as said, were not originally very rich. The

average production of these wells was never large. The only figures now available are for the year 1899, when 175 wells produced 270,000 barrels, or an average of 4.2 barrels per day per well — this when the average age of wells could not have been more than two or three years. It is probable, however, that the more favored portions of this area would still be producing at a profit, were it not for the very great increase in real estate values in this portion of the city, which has made it more desirable to clear the land than to produce small quantities of oil.

Western Avenue Wells.

In the year 1900, when Watts' Bulletin 19 of the State Mining Bureau was issued, no work had been done west of Rosedale avenue except two shallow holes, not productive, drilled by Messrs. C. B. Davis and Mitchell & Stilson, near Western avenue and Temple road. The statement is also made that a productive well had been drilled farther to the west prior to this time, and probably in the group in the southeast quarter of section 14.

In 1906 the U. S. Geological Survey reported 12 producing and 86 abandoned wells in the S.W. ¼ of 13, the N.E. ¼ of 23, the S.E. ¼ of 14, and the N.W. ¼ of 24, all in township 1 south, range 14 west. As no information is at present available regarding these wells except such as is conveyed in Bulletin 309 of the Geological Survey (Los Angeles District — Ralph Arnold) the following is quoted verbatim from this bulletin:

> The formations underlying the area east of the corner of Western avenue and Temple road are the same as those found toward the southeast in the region of the Baptist College. The surface outcrops seem to indicate that the dip of the beds is toward the southwest, but from the evidence offered by a group of wells just south of Temple road one fourth mile east of Western avenue, the dip appears to be south-southeastward about 4 feet in 300 feet. This discrepancy is doubtless due to the proximity of the area to the axis of the Los Angeles anticline.
>
> The wells in the northern part of the area, near Temple road, after penetrating gravel and sand for approximately 100 feet pass through alternating clayey shale and fine sandstone for about 250 feet. At this depth the oil sand, which appears to be barren at the top but productive below, is encountered and extends for 35 feet. About 20 feet below this is a layer of sand which yields flowing water. The wells in this part of the area yield an average of 1 to 2 barrels of 15° oil per day; and in addition considerable quantities of gas and usually about 2 per cent of water.
>
> About one fourth mile to the southwest down the dip from the territory just described the wells reach the oil sand at 310 feet. The sand is here 40 feet thick and is somewhat more productive than it is higher up, yielding on an average 6 barrels per day per well. The same strata were penetrated and the same amount of water is encountered in these deeper wells as in the wells to the northeast.
>
> Still farther southwest, about one half mile southwest of the corner of Western avenue and Temple road, the wells strike an oil sand at a depth of about 350 feet which outcrops at the surface in the vicinity of the wells just described. About 350 feet below this upper oil sand is encountered a second oil zone corresponding to the productive sand of the wells half a mile to the northeast. The strata above the first sand are largely clayey and sandy gray shale, possibly Fernando in part, with some harder shale and "shell" layers immediately above them. Between the first and second oil zones are alternating clayey and sandy shale with a few thin layers of hard siliceous shale or "shell"; isolated accumulations of oil and gas occur throughout these beds.

The underground geology in the vicinity of the little group of wells in the S.E. ¼ section 14, T. 1 S., R. 14 W., one fourth mile northwest of the corner of Temple road and Western avenue, introduces a new structural factor in the shape of a northeast-southwest line of disturbance. In a journey westward through the western field this is the first evidence encountered of the secondary zone of disturbance, which to the southwest develops into the Salt Lake flexure. The line of disturbance or fault appears to extend in a southwesterly direction from the northeast corner of the S.E. ¼ section 14, through a point 80 feet west of Loma Vista well No. 5, and thence indefinitely toward the Salt Lake field.

East of this line of disturbance the main oil zone, which is here from 80 to 90 feet thick, is encountered at a depth of between 195 and 210 feet, the overlying beds consisting of Pleistocene sand and gravel near the surface, with thin-bedded shale and fine sandstone below. The wells yield as high as 20 barrels per day when they first come in, but this production falls off, and at the end of two years is in few cases over 2 barrels. The original high production is caused by the gas pressure, which is rather strong in this area. West of the line of disturbance water is encountered in the wells at a depth of 400 feet, but no oil was struck, though one of the wells was continued to 580 feet.

QUALITY OF CITY FIELD OILS.

The oils of the City field, while varying considerably in gravity, are uniform in quality, as is indicated by the following analyses.

The large percentages of light products and of asphalt shown by the Salt Lake oils are notably absent. Not a single sample of the fifteen reported here shows any distillate lighter than stove oil, though the samples cover a range from 11° to 18° Beaumé. As to this point the comparison with Sale Lake oils is rather striking, as these oils commence to yield a little kerosene at about 11° Beaumé (gravity of crude), and at 18° usually show some gasoline.

In respect to percentage composition the City oils show a marked resemblance to those of Whittier, which are also very low in light products and asphalt. In both these cases the oils appear to be debased, being produced from narrow sands paralleled by zones of faulting, while in Salt Lake the faults which limit the productive area are widely separated, and are apparently sealed by the consolidation of soft sediments, thus protecting the oils from degeneration except at the edges of the field.

The City oils contain much more sulfur than those of Whittier, and in this respect approach, though they do not equal, those of the Salt Lake area. They are thus unfitted for gas manufacture, and because of the entire absence of light products, are of little value for refining. The lubricants are of good quality and in fair quantity, but the asphalt yield is not large, and lubricants as a main product are rarely profitable under present market conditions. These oils, therefore, find their principal market as fuel, for which there is a large local demand.

7428.*

Los Angeles Railway Company. Hubbel No. 2. (West Field.)

Gravity ---------- 16.5° Beaumé
Viscosity at 185° F. ---------- 2.61 Redwood

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 482° F.	9.7 per cent	32.0 Beaumé
482 to 572°	15.8 per cent	26.8°
572° to grade—a	43.4 per cent	24.2°
572° to grade—b	8.2 per cent	24.7°
Asphalt	21.5 per cent	Grade "D" (about)
Loss	1.4 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	9.0 per cent
Middlings and lubricants	24.9°	68.1 per cent (not separated)
Asphalt	"D"	21.5 per cent
Loss	---	1.4 per cent
		100.0 per cent

7427.*

Westlake Oil Company. Well No. 7. (Middle Field.)

Gravity ---------- 12.0° Beaumé
Viscosity at 185° F. ---------- 19.57 Redwood

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 572° F.	29.0 per cent	25.0° Beaumé
572° to grade—a	31.2 per cent	22.8°
572° to grade—b	3.6 per cent	22.6°
Asphalt	33.1 per cent	Grade "D" (about)
Loss	3.1 per cent	
	100.0 per cent	

This is equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	None
Middlings and lubricants	23.8°	63.8 per cent (not separated)
Asphalt	"D"	33.1 per cent
Loss	---	3.1 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

6457.*

Parker Oil Company. Well No. 30. (Middle Field.)

Gravity ..... 12.6° Beaumé (corrected for water 13.5°)

This is a thick oil, of a brownish-black color, and with a mild odor. This well is located just west of the Sisters' Hospital, at the east end of the middle field. The sample as received contained 21 per cent of water, which was not emulsified and settled slowly.

Distillation.

Sample of 200 c.c., distilled from copper in a current of gas to a residue of dry coke.

First cut	20.9 per cent	32.6° Beaumé
Second cut	68.8 per cent	18.7°
Fixed carbon	10.3 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	20.0 per cent
Fuel distillate	29.2°	17.9 per cent / Slop distillate
Reduced stock	12.5°	36.3 per cent \ 18.7°—54.2%
Asphalt	"D"	25.8 per cent, or 90.6 lbs. per bbl.
		100.0 per cent

The stove oil from this run was pale and with slight bloom, but had a marked still odor, which largely disappeared on treatment.

The lubricating stock had a good color and a rich green outer tone, both of which were also noted on the reduced stock. The viscosity of the latter was high, and there was no paraffin. This appears to be a good grade of crude for lubricants, but as usual in this field, the yield of asphalt is low for the gravity.

*Analysis by J. P. P.

2413.*

Sample from Middle Field.

Gravity	13.5° Beaumé
Flash point	258° F., open test
Viscosity at 76° F.	730.4 Engler
Sulfur	1.08 per cent by weight

Distillation.

Sample of 100 c.c., distilled from glass flask without steam or gas.

Below 302° F.	None	
302 to 572°	10.0 per cent	
572° to asphalt	59.0 per cent	
Asphalt	31.0 per cent	Grade "D"
	100.0 per cent	

Very roughly equivalent to the following commercial analysis:

Gasoline	None
Engine distillate	None
Kerosene	None
Stove oil	10 per cent
Middlings and lubricants	59 per cent
Asphalt "D"	31 per cent
	100 per cent

7430.†

E. B. Clampitt. Well No. 1. (Middle Field.)

Gravity	13.8° Beaumé
Viscosity at 185° F.	5.40 Redwood
Sulfur	1.30 per cent by weight

Distillation.

Sample of 200 c.c., distilled from glass flask without steam or gas.

Below 482° F.	5.9 per cent	32.1° Beaumé
482 to 572°	14.1 per cent	27.7°
572° to grade	47.2 per cent	25.1°
Asphalt	28.8 per cent	Grade "D" (about)
Water and loss	4.0 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	5.0 per cent
Middlings and lubricants	25.7°	62.2 per cent (not separated)
Asphalt	"D"	28.8 per cent
Loss	---	4.0 per cent
		100.0 per cent

*Analysis by P. W. P.

†Analysis by H. N. Cooper.

7429.*

Park Crude Oil Company. Well No. 13. (Middle Field.)

Gravity ---------- 14.2° Baumé
Viscosity at 185° F. ---------- 4.42 Redwood
Sulfur ---------- 1.18 per cent by weight
Thermal value ---------- 18,623 British thermal units

Distillation.

Sample of 200 c.c., distilled from glass without steam or gas.

Below 482° F.	6.9 per cent	32.2° Baumé
482 to 572°	19.4 per cent	26.8°
572° to grade—a	39.7 per cent	22.2°
572° to grade—b	4.5 per cent	22.8°
Asphalt	25.3 per cent	Grade "D" (about)
Loss	4.2 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Baumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	6.0 per cent
Fuel distillate and lubricants	23.6°	64.5 per cent (not separated)
Asphalt	"D"	25.3 per cent
Loss	---	4.2 per cent
		100.0 per cent

7423.*

I. W. Shirley. Well No. 12. (Middle Field.)

Gravity ---------- 16.5° Baumé
Viscosity at 185° F. ---------- 2.83 Redwood
Sulfur ---------- 0.85 per cent by weight
Thermal value ---------- 18,787 British thermal units

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 482° F.	7.6 per cent	32.3° Baumé
482 to 572°	13.9 per cent	28.2°
572° to grade—a	40.0 per cent	25.2°
572° to grade—b	14.5 per cent	24.6°
Asphalt	21.8 per cent	Grade "D" (about)
Water and loss	---	
	100.0 per cent	

These figures are approximately equivalent to the following commercial analysis:

Gasoline	61° Baumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	7.0 per cent
Middlings and lubricants	25.0°	69.0 per cent
Asphalt	"D"	21.8 per cent
Loss and water	---	2.2 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

6458.*

Doran, Brouse & Price. Average. (East Field.)

Gravity ..... 11.2° Baumé
Gravity corrected for water ..... 11.7°

This is a thick, reddish-brown oil, containing as received 30 per cent of water, very finely divided. While this water is intimately blended with the oil, it does not appear to be actually emulsified, as it settles out on slow heating.

Distillation.

A sample of 200 c.c., distilled from copper in a current of gas. Distillation carried to a residue of dry coke.

First cut	12.9 per cent	32.6° Baumé
Second cut	80.0 per cent	16.5°
Fixed carbon	7.1 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Baumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	12.5 per cent
Fuel distillate	28.7°	22.3 per cent / Slop distillate
Reduced stock	12.8°	47.4 per cent \ 16.5°—69.7%
Asphalt	"D"	17.8 per cent, or 62.5 lbs. per bbl.
		100.0 per cent

The stove oil ran pale and sweet, and treated well. The lubricating and reduced stocks had a fine color and outer tone, and the high viscosity normal to the very low gravity. There was a faint trace of paraffin in the reduced stock, which commenced to crystallize at about 75° F.

While this analysis does not indicate the points of difference, this oil is of quite different constitution from the adjacent Harris oil (6452).

7431.†

Consolidated Crude Oil Company. Well No. 21. (East Field.)

Gravity ..... 12.6° Baumé
Viscosity at 185° F. ..... 18.30 Redwood

Distillation.

Sample of 200 c.c., distilled from glass flask without steam or gas.

Below 482° F.	8.4 per cent	32.0° Baumé
482 to 572°	14.0 per cent	26.4°
572° to grade—a	29.3 per cent	25.0°
572° to grade—b	17.6 per cent	22.5°
Asphalt	29.4 per cent	Grade "D" (about)
Loss	1.3 per cent	
	100.0 per cent	

*Analysis by J. P. P.
†Analysis by H. N. Cooper.

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	7.0 per cent
Middlings and lubricants	24.6°	62.3 per cent (not separated)
Asphalt	"D"	29.4 per cent
Water and loss	---	1.3 per cent
		100.0 per cent

7425.*

Davis & Harrison. Well No. 10. (East Field.)

Gravity ---------- 13.2° Beaumé
Viscosity at 185° F. ---------- 11.96 Redwood
Sulfur ---------- 0.49 per cent by weight
Thermal value ---------- 18,164 British thermal units

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 572° F.	17.1 per cent	27.1° Beaumé
572° to grade—a	43.6 per cent	24.1°
572° to grade—b	8.3 per cent	23.2°
Asphalt	28.3 per cent	Grade "D" (about)
Loss	2.7 per cent	
	100.0 per cent	

This is approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	None
Middlings and lubricants	24.8°	69.0 per cent
Asphalt	"D"	28.3 per cent
Loss	2	2.7 per cent
		100.0 per cent

6452.†

Harris Oil Company. Average. (East Field.)

Gravity ---------- 13.1° Beaumé
Gravity corrected for water ---------- 13.4°

This sample was a tank average from the station at Adobe and Castellar streets, in the east field. It contained 8 per cent of water as received, not emulsified. This is a thick, black oil, with a mild and sweet odor.

Distillation.

Sample of 300 c.c., distilled from copper in a current of gas. Distillation carried to a residue of dry coke.

First cut	15.1 per cent	31.9° Beaumé
Second cut	76.5 per cent	20.4°
Fixed carbon	8.4 grams per 100 c.c.	
	100.0 per cent	None

*Analysis by H. N. Cooper.

†Analysis by J. P. P.

On reduction of the second cut in a stream of gas, and calculation of the residue to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	12.0 per cent
Fuel distillate	29.9°	24.1 per cent / Slop distillate
Reduced stock	15.3°	42.9 per cent \ 20.4°—67.0%
Asphalt	"D"	21.0 per cent, or 73.7 lbs. per bbl.
		100.0 per cent

The lubricating stock from this crude was of quite different quality from that obtained from the preceding sample (6468), being pale in color, but rather bluish, with a mild sulfurous odor, and a low viscosity. The reduced stock also showed these properties, but developed no indications of paraffin.

7424.*

Proudfit & Parker. Well No. 2. (East Field.)

Gravity	14.3° Beaumé
Viscosity at 185° F.	4.71 Redwood

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 482° F.	4.0 per cent	30.3° Beaumé
482 to 572°	13.9 per cent	27.2°
572° to grade—a	42.8 per cent	24.1°
572° to grade—b	8.3 per cent	26.3°
Asphalt	28.8 per cent	Grade "D" (about)
Water and loss	2.2 per cent	
	100.0 per cent	

These figures are approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	None
Middlings and lubricants	25.3°	69.0 per cent (not separated)
Asphalt	"D"	28.8 per cent
Water and loss	---	2.2 per cent
		100 per cent

*Analysis by H. N. Cooper.

2471.*

Sample from East Field.

Gravity ..... 15.1° Beaumé

This is a rather limpid, brownish oil, with a mild odor.

Distillation.

A sample of 100 c.c., distilled from a glass flask to asphalt without steam or gas. Residue reduced to an 18.7° stock in vacuum. The original runs are:

Crude oil—		
Below 572° F.	21.5 per cent	30.2° Beaumé
572° to asphalt	64.2 per cent	23.0°
Asphalt	14.3 per cent	Grade "B" (hard)
	100.0 per cent	

Second cut from above—		
Fuel distillate	21.4 per cent	31.8° Beaumé
Reduced stock	42.8 per cent	18.7°
	64.2 per cent	

On bringing these figures together they give the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	16.0 per cent
Fuel distillate	31.8°	26.9 per cent
Reduced stock	18.7°	42.8 per cent
Asphalt	hard	14.3 per cent
		100.0 per cent

2463.†

Sample from East Field.

Gravity ..... 15.7° Beaumé

This is a thick, brownish-black oil of mild odor.

Distillation.

Sample of 100 c.c., distilled from glass to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are:

Below 302° F.	None	
302 to 572°	17.2 per cent	30.2° Beaumé
Residue above 572°	82.8 per cent	12.7°
	100.0 per cent	

*Analysis by P. W. P.

†Analysis by Wayne Colver.

After evaporation to asphalt and calculation these figures are roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	13.0 per cent
Middlings and lubricants	---	63.4 per cent (not separated)
Asphalt	"D"	23.6 per cent or 82.8 lbs. per bbl.
		100.0 per cent

7426.*

Davis & Harrison. Solano well. (East Field.)

Gravity	17.9° Beaumé
Viscosity at 60° F.	61.59 Redwood
Viscosity at 185° F.	1.99 Redwood

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 482° F.	6.6 per cent	33.4° Beaumé
482 to 572°	17.5 per cent	28.1°
572° to grade—a	47.8 per cent	23.9°
572° to grade—b	9.8 per cent	24.0°
Asphalt	17.3 per cent	Grade "D" (about)
Loss	1.0 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	7.0 per cent
Middlings and lubricants	24.8°	74.7 per cent (not separated)
Asphalt	"D"	17.3 per cent
Loss	---	1.0 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

CHAPTER XII.

SALT LAKE OR SHERMAN FIELD.

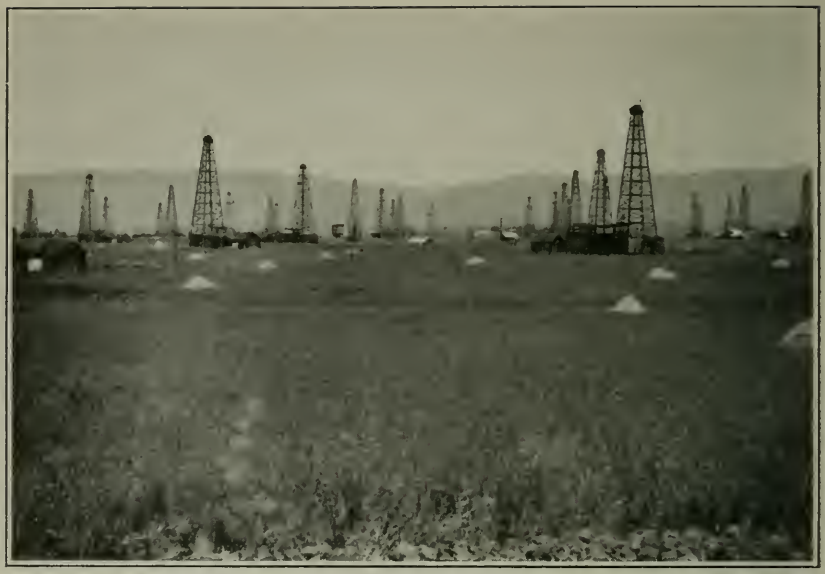
The group of wells lying between the western city limits of Los Angeles and the Pacific Ocean was first known under the name Sherman, from a small town a short distance to the north, but is now more generally known as the Salt Lake field, a name borrowed from that of the first and largest operating company.

Topography and Climate. The Salt Lake field occupies a tract of nearly flat land at the foot of the Santa Monica range, but distant some two miles from the base of the mountains, which lie to the north. The ground slopes gently to the south and west, the elevation above sea level at the north margin of developments being about 250 feet, at the southeast corner about 200 feet, and at the southwest corner of the main field about 150 feet. The entire field is drained through gentle swales, having a direction somewhat west of south, and carrying storm waters into Ballona creek.

West of the main group of wells a low ridge makes off from the Santa Monicas in a southeasterly direction, or at right angles to the mountain axis. This ridge crosses the long axis of the main group about 2½ miles west of the most westerly wells. On this ridge, elevated less than 100 feet above the plain, a secondary group of wells has been drilled, known as the Beverly Hills wells. This group does not lie exactly in line with the Salt Lake wells proper, the axis of the Salt Lake group intersecting the Beverly ridge about one half mile north of the center of the latter group. These hills are hardly more than a gentle undulation of the plain, and their rounded summits lie approximately level with the upper edge of the main field. Farther to the southeast, and across Ballona Creek, the hills are much higher, and are known as the Redondo or Tijera hills.

The climate of this region is the far-famed climate of Los Angeles, dry and moderately hot in summer (the daylight temperatures ranging from 70° to 90° F.), with a rather small rainfall (some fifteen inches per annum) and mild temperature in winter. In this respect few fields anywhere are more favored, there being but few days in the year when outdoor labors can not be pursued in perfect comfort.

Underground conditions. The Salt Lake field is peculiar among the oil districts of California in that the surface is entirely covered by late sediments, so that no hint whatever is given by the surface as to the structure beneath. It follows from this that whatever we learn as to underground conditions here must be gathered from the results of drilling, but while the field has now been thoroughly drilled up, and demon-



La Brea Lease; Salt Lake Oil Field, Los Angeles County.

Pitch Lake, Rancho La Brea, Los Angeles County.

strated in all directions, the drilling data is in the main kept very secret, so that even at this late date but little can be learned as to some parts of the field. For these reasons, such well records as were obtainable in the circumstances are given first, while the general descriptions usually given at the beginning of each chapter will, in this, follow the records. It may, however, conduce to a better understanding of these notes to state in advance that the strata penetrated by these wells consist, in the main, of soft shales, clays and loose sands; that the oils are produced from incoherent sands, and that the shallow wells at the east are generally free from water, while the deeper wells at the western end are much troubled in this regard. As to structure, the sands approach close to the surface at the northeast corner of the developed field, and dip a little south of west, the dip being rather even in the eastern portion of the field, but much disturbed at the west end. The field appears to be definitely bounded at the north and south, and perhaps also at the east, by zones of faulting, while at the west the producing formations are found in place, but cease to be remunerative because of an excess of water. The Beverly wells, and the group south of Wilshire boulevard, are in different formation, and will be considered separately. These wells were last visited in January, 1912.

Rancho La Brea Oil Company. This company has a compact group of twenty-eight wells on the southwest quarter of section 15, 1–14. Of these wells, three are drilling, two are suspended, one is abandoned, and twenty-two are producing.

These wells are all at the northeast corner of the field, and at the point where the sands approach closest to the surface. They are therefore shallow holes, and produce a very heavy oil.

Well No. 42, at the northeast corner of the tract, was finished at 799 feet, and is an average producer. No. 44, the next location to the south, was 805 feet and drilling in January, 1912, and was going deeper, though it already had a good showing of oil. No. 46, two locations to the south and on the east line, got only water to 1000 feet, and was going deeper, though not then working. It will be noted that the Salt Lake wells immediately south produce at from 1050 feet to 1300 feet.

On the north line, Well No. 47, a location to the northwest of No. 42, is drilling. Well No. 45, one location farther west, is making a small amount of oil, but more water than oil, and No. 34 was being cemented when last visited. This latter well uses 640 feet of tubing, and is probably finished at something less than 700 feet. Of the other wells, No. 16 had much upper water and only a small amount of oil, and was not being operated at this time. The well lying between Nos. 20 and 46 is an old abandoned well, noted below.

The wells farthest up the formation, which here dips to the southwest, have very little trouble with water, not enough to seriously hamper

their operation. On the southwest corner of the quarter, however, much water is encountered above the oil, and is hard to handle. When pumped with the oil the water does not emulsify, and is readily separated by steaming.

The oil over this entire quarter is very heavy, and somewhat heavier at the east than on the west side of the group, as is usual in such cases. All the wells produce from loose sands, and make considerable solid matter with the oil, mainly a fine sand. On the other hand, gas pressures are low, and wells do not require so much cleaning as they do on the next section west. All these wells are handled on the beam.

On the south line of section 16, one half mile to the west of the group just mentioned, this company is pumping three wells, and was drilling one in January of the current year. The oil from these wells, while heavy, is rather lighter than that from the wells either south or east, and these three wells appear to be more liberal producers than the average for this portion of the field.

On the narrow strip lying between the Salt Lake and the Clark-Sherman leases, in the northeast quarter of section 21, 1–14, this company has fifteen wells, all producing. These are the oldest wells on the entire property, and were started about the year 1908. They range from 1350 feet to 1600 feet in depth, and operate under the same conditions as those on adjoining leases.

On the southeast quarter of section 15, 1–14 there was formerly a group of eleven wells, all now abandoned. Very little is known about these wells except that they were shallower than the producers on the quarter to the west, and that they got very little oil, and this so extremely heavy that it could not be handled. Three of these wells (probably, but not certainly, the ones indicated as such on the map) were drilled prior to 1900, and are known in the older reports as the Rhodes wells. The following records as to these wells, given by W. L. Watts in Bulletin 19 of the Mining Bureau, will indicate the general character of this formation:

Rhodes wells. No. 1, on Brea Ranch, about 4 miles west of Los Angeles. Formation: Soil to 10′; yellow clay-shale to 73′; sand and boulders to 85′; blue clay to 149′; shell to 154′; blue clay to 175′; shell to 177′; decomposed black shale to 192′; shell, or hard flinty blue shale to 193′; oil sand to 213′; gray shale to 214′; oil sand to 237′; sand rock to 239′; oil sand to 282′; sand rock to 284′; heaving beach sand to 324′; coarse black sand with asphaltum to 350′; hard rock to 351′; lightish-colored sand to 381′; hard oil rock to 382′; oil sand (showed well) to 432′; soft oil rock of shale to 436′; coarse sand to 463′.

Well No. 2, on Brea Ranch, about 800′ south of Rhodes well No. 1. Formation: Soil to 10′; red sand to 50′; yellow clay and shale to 133′; shell to 137′; sand and boulders (water strata) to 147′; blue shale to 185′; shell to 186′; shale to 215′; shell to 216′; clay to 255′; brea to 256′; shale to 284′; shell to 285′; shale to 302′; shell to 304′; shale and clay to 362′; shell or rock to 363′; shell to 370′; oil sand (6″ shale about center) to 449′; rock to 452′; oil sand to 484′; rock to 485′; sand to 527′; sand rock to 535′; sand to 546′; shale to 548′; oil sand to 596′; hard shale or rock to 600′. This well was drilled by a hydraulic rig. Two days after removing the pipes the oil stood within 12′ of the surface. The gravity of the oil is 12° B.

Rhodes well No. 3, on Brea Ranch, about 800′ southeast of No. 1. Formation: Soil to 10′; yellow clay and shale to 74′; sand and boulders (water strata) to 89′; shale to 104′; shell to 106′; blue clay to 173′; shell to 179′; decomposed black shale to 211′; shell of hard blue shale to 212′; oil sand to 245′; gray shale to 248′; oil sand to 264′; hard sand or sand rock to 265′; oil sand to 267′. Casing would drive no further. Took out 20 barrels twenty-four hours after cleaning well. Gravity of oil, 11° B.

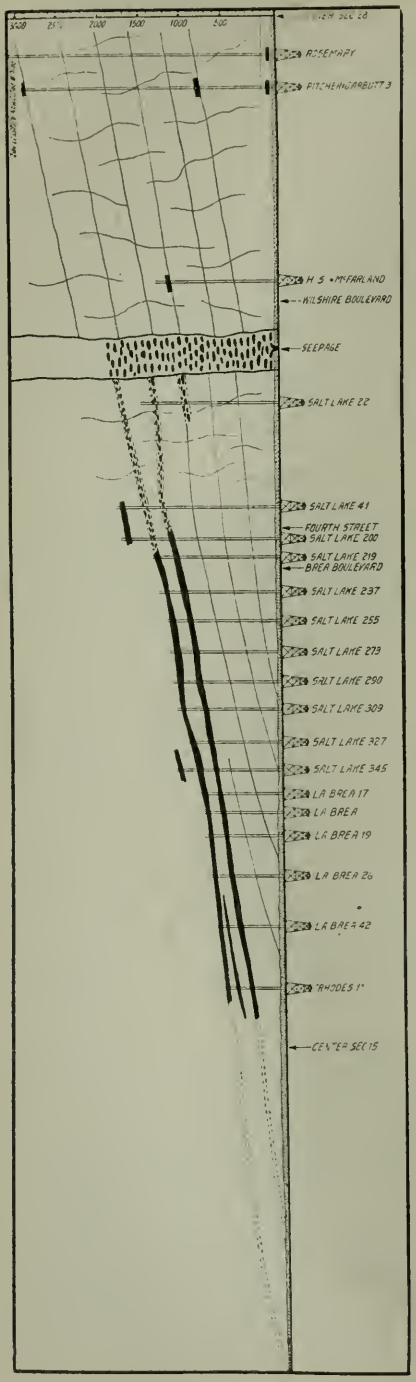
The well between No. 46 and No. 20 on the south line of the southwest quarter was drilled to a considerably greater depth. The full log of this well is given by Ralph Arnold in Bulletin 309 of the U. S. Geological Survey. In brief, this well found first tar sand at 772 feet, a streak of heavy oil between 890 feet and 925 feet, and other tar sands at short intervals all the way to the bottom, 1544 feet. This well was not considered a producer, and was abandoned, but other wells have since been drilled on all sides, getting their production, in the main, between this 772-foot sand and the 1100-foot level.

It is evidenced by the results from these wells that the sands come very close to the surface at the center of the southeast quarter of section 15, closer in fact than would be indicated by the even dip across the northwest quarter of section 22. It is probable that a line of faulting cuts across the producing formation near the east line of 15 and 22, and this, if true, would account for the fact that the easternmost wells farther to the south found only tar, even at depth.

Amalgamated Oil Company—Salt Lake Oil Company. The property originally developed by the Salt Lake Oil Company of Los Angeles, and comprising the west half of west half of section 23, all of section 22, the east half of the east half of northeast quarter of section 21, and all that portion of the same section lying south of Fourth street, has now for some years been owned and operated by the Amalgamated Oil Company, a subsidiary of the Associated Oil Company. On this property there are a total of 120 wells, of which 67 are on the western portion of the area north of Fourth street, while 53 are on section 21, south of Fourth street. As these two groups are quite distinct, both as regards underground structure and operation, they will be described separately.

The wells north of Fourth street are laid out in straight east and west rows, spaced 346 feet 8 inches, with adjoining rows "staggered," so that any three wells form an isosceles triangle. This arrangement is very suitable in such a case as this, but is only possible in flat country. The locations rather than the wells are numbered, so that many numbers are missing, none of the lines being as long as originally laid out.

Over the drilled-up area, fully one fourth of a square mile, every location is occupied, and depth, character of oil and operating conditions are more uniform than in any other equal area in the State, unless perhaps in some parts of Kern River. The producers farthest east give a slightly heavier oil and smaller yield than those on the west line, and are from 250 feet to 450 feet shallower.



On the eastern margin of the group are five abandoned wells, Numbers 350, 352, 359, 314 and 244. The exact depth of these wells can not be learned, but it is understood that they went at least as deep as the producing wells just west, and it is certain that they found the oil too heavy to pump—a thick, viscous tar. This was also the case with No. 209, a prospect hole to the southeast of the group. As these wells are much deeper than the producers of the La Brea, on the quarter to the north, the conclusion is unavoidable that some serious underground disturbance has probably allowed the oil to escape in part, and certainly to depreciate by evaporation or by contact with water, both of which tend to remove the lightest constituents and thus increase the viscosity.

Along the north line the depth of wells increases toward the west, at the rate of about nine feet in the hundred. Thus, No. 349, farthest to the east, is 1024 feet deep; No. 345, in the center of the line, is 1213 feet, and No. 340, at the west end, is 1313 feet deep. It is to be noted, however, that No. 343 was deepened from 1240 feet to 1386 feet, and is understood to have had its production increased thereby.

Along the west line, the depth increases from north to south, but more rapidly, the average dip approximating sixteen feet in the hundred. This dip is less regular than from east to west, there being a flat spot from No. 322 to No. 252, or over half the width of the strip.

while south of this the sand drops off rapidly. Thus, No. 340 is 1313 feet, No. 322 is 1476 feet, No. 252 is 1410 feet, with intervening locations running close to this figure, while No. 235 is 1550 feet, No. 217 is 1602 feet, and No. 200 is 1828 feet deep. This flattening on the north half with an abrupt dip farther south is noticeable about half way across the quarter section, the dip in the southern part gradually decreasing until east of the center it is hardly observable, and the sands lie practically flat in a north and south direction.

Starting from No. 42 on the Brea, and taking the nearest approximation to a straight line to No. 200 on the Salt Lake, we find a dip to the southwest of 1029 feet in a distance of 5030 feet, or an average of twenty and one half feet per hundred. This dip, however, is far from regular, being 26 per cent from Brea 42 to Salt Lake 346, zero from the latter well to Salt Lake 273, nineteen per cent from this well to Salt Lake 219, and sixty per cent from Salt Lake 219 to Salt Lake 200. The detail logs of these wells are not available, but it is probable that a part of this increase of depth is due to a thickening of the producing sands toward the southwest. The sections in Figure 28 indicate the lay of these sands in the three directions noted.

All of these wells make sand, and some of them a large amount, but this occasions less embarrassment with very heavy oils than with those of less consistency, as the sand remains in suspension longer in these very viscous oils, and less cleaning of wells is required than might be anticipated. Some water is produced with the oil, more on the west than from the eastern wells. As already noted, this water does not emulsify, and as the oils require to be heated to remove sand, the water is settled out at the same time, and at small cost. Heating is done in open wood tanks with steam coils, a method which would be extravagant of fuel were not an ample supply of gas available from the wells.

The viscosity of these oils is so great that it would probably preclude pumping them from much deeper wells, and a number of unusual expedients are practiced in handling them. Though the beams are run at much less than the normal speed, and on a rather short stroke, the rods settle so slowly that if attached in the usual manner they would be likely to buckle on the down stroke. Many of these wells have therefore a slip-joint (a cross-pin sliding in a slotted tube), in place of the usual shackle, but where the rods fail to sink they are picked up with a jerk on the up stroke, and breakage of rods is very common. Pulling tubing on one of these tar holes is an operation which must be seen to be appreciated; the derrick floors are literally piled with hardened oil. Many of these wells, instead of pumping direct into the lead line, discharge into a small heating tank, close to the derrick, in which the oil is thoroughly liquefied before being transferred by a separate pump.

Clark & Sherman Land Company or Los Angeles Pacific Railway The small tract on the northeast quarter of section 21, and lying west and south of La Brea property, is usually spoken of as the Los Angeles Pacific lease, but is understood to be owned and operated by the Clark & Sherman Land Company of Los Angeles. On this tract there are 23 wells, of which all but Numbers 1 and 17 are productive.

Well No. 1 is a shallow hole, said to be only 350 feet deep, and though formerly productive is now considered exhausted. Well No. 17 was suspended when last visited, and does not appear to have ever had production. Numbers 2, 3, 4, 5 and 6, along the south end, are pumping on the jack, and are said to be shallow holes. All the other wells are pumping on the beam, with steam engines. These wells range from 1300 feet to 1600 feet in depth, and produce the same quality of oil as the wells east and west.

Pacific Light & Power Company. This lease is on the center line of section 21, north of Fourth street. Here there are 23 wells, of which the last is drilling, while all the balance are producing. Nothing is known as to the depths of these wells, but they probably run about the same as those of the Gilmore wells to the west, or from 1800 to 2000 feet. These wells all pump on the beam, and are driven by electric motors.

The northern portion of the Clark-Sherman lease has lately passed to the Pacific Light & Power Company, the line running just north of Clark Numbers 19 and 16. This puts the suspended Clark well, No. 17, on Pacific Light & Power Company property. Well 23 is being drilled just south of Clark No. 17, and a short distance north of the new line.

Gilmore Oil Company. On this property, the next to the east along the north line of Fourth street, are located 19 wells, of which 3 are abandoned, three were drilling at the beginning of 1912, and the balance are producing.

Numbers 1 to 8, the wells on the east line, are all in the neighborhood of 2000 feet deep, except for No. 8, which though originally of this depth is now badly sanded up, and pumping from about 1200 feet. This well formerly flowed from 50 to 75 barrels per day, but in attempting to deepen the hole the casing was wrecked. Numbers 1 and 3 are very small producers, and are pumped only on the day shift. No. 6 pumps steadily, and makes about the average for the field, while No. 7 flows in blobs, the oil on this side being very thick and heavy.

Well No. 15 was formerly a producer, but is now abandoned, the entire producing formation having shifted bodily, and cut off the casing so that a severed part could not be found. Well 15–B is now being drilled to replace the lost hole.

The sands dip sharply to the west, Well No. 16 being in the neighbor-

hood of 3100 feet deep. This well had much top water, which was not shut off, and for a time produced very little oil, but is now handled by a method not elsewhere noted. A second string of tubing is run down to the level of the water, and discharges a steady 2-inch stream of water, pumped from below the oil, while the usual oil pump lifts the oil from farther up. By this means the water is lifted as it comes in, without being allowed to mix with the oil, and a normal volume of oil is had from the well.

No. 21 is a drilling well also. No. 27 is a producer at a depth of 3120 feet, and No. 39 at 3060 feet, these being tubing depths. No. 47 is a flowing well at about 3800 feet, and is making an oil of about 20° Beaumé, the lightest on the lease. It will be noted that the sands pitch off very sharply in this direction, and that the gravity increases very rapidly with increase of depth. It is said that these deeper wells find the same producing sands as the heavy-oil wells up the dip of the formation, and not a lower sand.

The two wells on the west line, and north of the main group, were carried to depths of 1700 feet and 1900 feet, approximately. These wells both got oil, but it was too heavy to be pumped, and the holes were abandoned.

Amalgamated Oil Company—Salt Lake Oil Company. On that portion of the Salt Lake property lying south of Fourth street there is a total of 53 wells, of which four are abandoned, while 49 are more or less productive. Almost nothing can be learned as to these wells. The two abandoned holes to the southeast of the group, Numbers 22 and 46, are known to have gone to the calculated depth and found the sands, but with tar instead of oil. Nothing is known as to the two dead wells on the west line, except that they are now flowing a little heavy oil.

The first wells in the field were drilled near the center of this property, and a number of these older wells are now being pumped on the jack. Toward the west line the oil is lighter than at the east, the production on this side closely resembling that north of Fourth street. The production of this lease seems to be much depreciated, and probably now cuts but a small figure in making up the total for the field.

Amalgamated Oil Company—Arcturus Oil Company. That portion of section 22 lying between Fourth street and the south and west lines of Rancho La Brea was formerly operated by the Arcturus Oil Company, but is now the property of the Amalgamated Oil Company. On this tract there are 45 wells, of which 4 were drilling in January, 1912, while 5 had been abandoned, and the balance were producing. Nothing could be learned as to the depths of these wells, though, in a general way, they are 2500 or 2600 feet deep on the west, and somewhere about 2000 feet on the east line. There appear to be local flexures of some

magnitude, with generally east and west axes, which effect both the depth and productiveness of closely adjacent wells.

The older wells along the east line appear to be small producers, and make a heavy oil, down to 14° at the north, and approximately 16° Beaumé at the south line. Farther west some of the wells have been very heavy producers, some flowing thousands of barrels per day, in the main giving a lighter oil. At one time there was an important yield of oil as light as 25° Beaumé, though there does not now appear to be anything lighter than 22° Beaumé, and none of the wells are flowing. The depreciation of these wells is of course due in part to the inevitable exhaustion of the gas pressure, but has without doubt been hastened by the intrusion of water, which has seriously damaged parts of this territory, particularly toward the northwest. Several of these wells, formerly good producers, now make hardly anything but water.

Garbutt Oil Company. This lease lies north of the Arcturus, and next west of the Gilmore tract. On this property there are thirteen wells, of which 4 are producing, 5 are abandoned, 2 are suspended and probably abandoned, one is drilling, and one is being worked on, in the attempt to shut out water. The depths of these wells are not known.

The well in the southeast corner of the tract, and No. 6, next to the west, are abandoned, and are said to have had water and only a little tar. Numbers 5 and 3, next to the west on the south line, and Numbers 10 and 11, just to the north of these, are producers, making a rather small output of oil of about 17° Beaumé, with considerable water. Well No. 2, on the south line, is suspended, and is said to have had much water and only a little oil of normal gravity. Nothing is known as to No. 1, in the southwest corner, which is an abandoned hole.

Well No. 6, one location to the north, is a producer, and is said to be the best well on the lease. No. 7, just north of this, is now being worked on. It had some oil, but was not a satisfactory producer. No. 13, east of 7, is drilling. No 8, some distance to the north of 7, but on the west line, and No. 12, northeast of No. 11, are abandoned, and are said to have found the oil too heavy to lift.

While no logs are available, it is sufficiently evident that some sort of a local disturbance in the formation crosses this tract from northwest to southeast, and that wells adjacent to this fault get only a debased oil, and much seepage water. The identification of a fault here would account for the large amount of water found in all the wells from this point west, it being evident that not all this water is following up the formation from the west.

American Petroleum Company—Niles lease. This property lies between the Garbutt lease and the west line of Rancho La Brea, and north of Fourth street. Here there are twelve wells, of which ten are

producers, and two abandoned. No. 9, the farthest well to the northwest, was plugged with a bit at 1100 feet and abandoned, while No. 10, farthest to the north on the east line, was only started.

Nothing is known as to the depths of these wells, except as to No. 17, which is producing from 1700 feet. These wells pump on the beam, and make a small amount of an oil approximating 18° Beaumé, and a very large amount of water, many times the volume of the oil. The fluid is run into open pools, from which the water drains at the bottom, and as the oil is not emulsified it is thus recovered. These wells are said to have formerly produced a dry oil.

McDor Oil Company. On the L. T. Swall tract, just west of the Niles lease, the McDor Oil Company drilled three holes, at least one of which was quite deep. No commercial oil was found, and the wells were abandoned.

Grador Oil Co. This company drilled one well on the J. A. Swall tract, west of the McDor lease. This was a deep hole, and found little oil.

Sherman Oil Company. The abandoned well northwest of the Grador hole, and just south of the Santa Monica electric line, was drilled by the Sherman Oil Company some years ago. It is believed to have been shallow.

Amalgamated Oil Company—West Coast Oil Company. North of Fourth street and west of the ranch line are seven wells belonging to the West Coast Oil Company, of which four were abandoned, two producing and one drilling in January, 1912.

Numbers 1, 2 and 3, on the east line, and No. 18, on the south line, were still cased but were not rigged for pumping when visited. There were no indications of these wells having ever produced. These wells are said to have had a great deal of water.

Well No. 19, the next location to the west, was on the beam, and was making a little very heavy oil, about 14° Beaumé, and not very much water. This well is said to make a great deal of sand.

Well No. 20, next to the west, pumps by heads, and produces a rather larger quantity, and a much lighter oil, said to be 21.5° Beaumé. No. 25, the farthest to the west in this string, was formerly a heavy producer. It gave a great deal of trouble with sand, and was being deepened at 2640 feet when visited.

Amalgamated Oil Company—Rodeo Land & Water Company. This company has drilled twelve wells west and south of the West Coast property, all but one of which are now abandoned. The well farthest to the southeast went to 2600 feet, and got a little heavy oil, but not enough to make a producer. Numbers 4, 5, 9, 10, 11 and 12 ran from 2800 to 3000 feet, and all had some oil, but too much water to allow

them to be operated at a profit. Well No. 3, in this same group, is now drilling. Nothing is known as to the three abandoned wells north of the electric line.

Development and Probable Limits of the Field. The Salt Lake field proper, not including Beverly, has been demonstrated and in the main drilled up over an area of almost exactly two square miles. To this area there is little likelihood of any material addition being made, as will be clear from an examination of even the imperfect notes above.

At the extreme northeast, an extension is being made toward the north, but work already done a short distance to the east shows the impossibility of any further drilling in this direction, and at the north the sands are so close to the surface that it is not likely that they can be followed much further with profit. There is, of course, the possibility that there might be here, as on section 20, a slight dip to the north which would carry the productive sands some distance farther, but as the formation is entirely hidden, and no prospecting whatever has been done, it is impossible to hazard a guess as to this. This leaves that portion of the northern limit lying within section 16 and the west half of section 15 open to possible extension, though only for small producers of very heavy oil.

On the east and southeast a definite limit to development has been set by a string of wells carried to sufficient depth, all finding the sand in place, but containing only a heavy and unprofitable tar. Without doubt a considerable area of this tar-producing ground exists, and under more favorable market conditions there might be a profit in producing such wells, but at the present price of oil, the 11° and 12° oil of the Salt Lake lease is fully as heavy as oil may be to allow of successful production.

On the south, the Hardison & Stewart well, southeast of the lagoon (described below) went to a sufficient depth to clearly prove the territory in this direction, and so much drilling has been done south of the assumed fault along the southern margin of the field that it is hopeless to look for anything beyond a possible development of very small, shallow wells in this direction. There always remains, of course, the chance of finding a new pool on this side, but only at a distance of not much less than two miles from present production.

On the northeast side of the strip extending across the west ranch line, conditions similar exist to those at the east end of the field, but complicated by the presence of much water. The territory to the north of the Gilmore, and northeast of American Petroleum, would seem to be thoroughly and finally condemned.

At the southwest side of the field less prospecting has been done than elsewhere, and while such as has been done has not been very encourag-

ing, there is still a chance for the development of productive territory. The four wells along the ranch line between Arcturus 10 and Arcturus 137 all showed some oil, and less water than the Rodeo wells farther west, and while the oil was heavy and the production small, it has hardly been shown, as yet, that no production exists on this side, though the probabilities are, it must be admitted, strongly against it.

At the western end of the field the sands lie so far down that it becomes very difficult to handle the large amounts of water found, in the soft formation available for shutting off. So that while most of these wells have shown some oil, and two or three have been very good producers indeed, the prospects for the territory as a whole are not encouraging. There can be little doubt that productive sands underlie at least a part of this ground, but whether wells at this depth can be successfully drilled in such wet ground, with any methods of drilling and cementing now known, is open to a grave doubt.

Statistics. The Salt Lake field differs notably from most of the California fields, in the small number of companies which have operated here, only thirteen companies having drilled wells north of Wilshire boulevard, that is, in the field proper. Of course, if the number who have operated in the southern extension were added, this figure would be more than doubled, but as this latter work was mostly done before the discovery of oil in Salt Lake, and was based on other indications, it is hardly chargeable to the development of this group. The proportion of successful operators is also unusually large, but four of the thirteen having failed to get commercial production.

At the beginning of the current year, 326 wells had been drilled in this field, divided as follows:

Wells now producing	258
Abandoned wells	47
Suspended, nominally productive wells	5
Drilling January 1, 1912	16
Total	326

The first deep drilling was done in this field in the year 1885, when Hardison, McFarland & Stewart drilled a short distance southeast of the lagoon. This lake of heavy tar, located on the north line of Wilshire boulevard, one fourth mile east of the west line of section 21, had been worked for asphalt for many years previous to this date, and was the single surface indication of petroleum on which prospect work was based. The first commercial production was had on the Salt Lake lease about the year 1902, but the bulk of the drilling in this field was done between the years 1905 and 1910. The average age of all the wells in the field is between five and six years.

The depths of the wells in this field run from a minimum of 800 feet

to a maximum of about 3000 feet. The average depth for all the productive wells in the field is not far from 1725 feet.

These wells were drilled through soft formation, almost entirely with standard rigs. No great difficulties have been experienced in drilling, other than in the shutting off of water, which becomes very troublesome in the western part of the field. Most of these wells pump on the beam, and aside from requiring considerable cleaning, give very little trouble. These wells do not bridge suddenly, as in fields where the gas pressure is high, but gradually fall off owing to the slow accumulation of sand.

The production of the Salt Lake field during its earlier years is difficult to arrive at with certainty, as only unofficial figures are available, and in these the output of this field is included with that of Los Angeles City. Fairly close estimates can be made as to the city production, so that if we could be certain as to the correctness of the totals, the margin of error in the Salt Lake figures would be small; the totals were published by the California Petroleum Miners' Association, but their original source is unknown.

Production for the year 1904 estimated at about 500,000 barrels. This is the first year in which any important amount came from this field.

Production for the year 1905 estimated at about 2,300,000 barrels. This figure is more likely to be too large than too small. At the end of this year there were about 80 wells pumping in this field, giving an average production per well per day of 79 barrels. This figure is probably correct within a limit of five barrels, one way or the other.

Production for the year 1906 estimated at about 1,200,000 barrels.

Production for the year 1907 estimated at about 1,500,000 barrels.

Production for the year 1909, 3,821,233 barrels *(Oil, Paint and Drug Reporter)*. On May 31, 1909, a count of the field showed 160 producing wells, giving an average of 66 barrels per well per day.

In the year 1910 the production fell off somewhat, being 3,247,507 barrels. No count of the wells is available for that year.

In 1911 the production decreased greatly, in spite of the drilling of a large number of wells during the previous two years. During this year the output was 2,815,097 barrels, while at the end of the year 258 wells were pumping, giving an average of 30 barrels per well per day. This number of producers is slightly larger than the average for the year, but not enough to make any material change in the average daily production.

Wells South of Wilshire Boulevard.

A large number of wells have been drilled south of the Salt Lake field proper, on the eastern portions of Ranchos Rodeo de las Aguas and Rincon de los Bueyes, and on the western portion of Rancho Las Cienegas. None of these wells found any commercial production of oil

except one small group, and these are not now producing, but a number found oil in small quantity. Only scattering records of these wells can now be found, and the prospects for the territory do not seem to warrant the labor of searching out such data, considering the period at which the work was done. In reference to the map locations in this part of the field, the wells lying between the electric road and Wilshire boulevard were located on the ground, and are at least approximately correct, though in two or three cases the identification of the record with the location is uncertain. South of the electric line, however, the locations were made from written descriptions, and these must be considered tentative only.

It may hardly be doubted that these wells south of the boulevard were drilled into fault material, and that the small quantities of oil found was seepage from the sands north of the fault. Most of the oil found was close to the surface, the logs of adjacent wells showed very little resemblance, and no true producing sands were found at any location nor depth, so far as can be learned. And the entire identity of the oils found, particularly in the two important and unusual characters of high sulfur percentage and large yield of light products for any given gravity, can hardly be a coincidence.

It does not follow, however, that the acceptance of this view would bar the possibility of productive measures farther south. Wells drilled immediately to the north of the fault were no more successful than those to the south, and considering the traces of oil, slight as they may be, which have been noted farther south, there is a strong probability that sands originally continuous with those of Salt Lake, or at least sands charged from the same source, do extend south of the fault zone.

If this be true, such sands would be commercially productive at any point where arching of the formation underlying the valley floor brought them within reach of the surface, and while such underlying arches, if they exist, are not indicated on the surface, and would have to be sought on very scanty indications, it seems strange that no prospecting has ever been done across the flat between the Salt Lake field and the Cienega hills.

Lombard & Lockhart. These parties are said to have drilled three wells on land of C. Greve and E. S. Whitworth, on the west half of section 29 and the east half of section 30, 1–14. Well No. 1, on Greve land, was 891 feet deep. Numbers 2 and 3 were on Whitworth land, and one of these is said to have gone into hard rock at 417 feet; the depth of the third is unknown. All these wells were abandoned, and had no oil. The locations shown on the map are uncertain.

Wicks et al are said to have drilled a 400-foot hole on the De Arnaz ranch, in the east half of section 31, 1–14. This well is abandoned, but is said to have had a showing of oil.

New Mexico Development Company. In 1900 W. L. Watts reports this company as drilling, at 600 feet, on the same property. The later history of this well is not known.

B. Lombard tract. On this property Ralph Arnold (Bulletin 309, U. S. Geological Survey) locates three abandoned wells, about which nothing can be learned. This property is in the east half of section 29.

Pico Oil Company. On the James Whitworth tract, in the southeast quarter of section 29, the Pico Oil Company drilled a well shortly before the year 1900. This hole was carried to a depth of 822 feet, and went through a succession of layers of black shale and blue clay, with almost continuous showings of oil from 538 feet down. No oil was found in sand, and the well was not a producer.

Rodeo Oil Company. This company is said to have drilled two wells on lands of Abbott and Lombard, on the east line of section 29. Well No. 1 was drilled to 723 feet, and went through a succession of layers of sand, soft sandstone, and blue clay. Oil was found in gravel between 53 feet and 76 feet, and from 593 feet to the bottom, showings were almost continuous, but the well was not a producer. The depth of well No. 2 is not known, but it is said to have gotten a showing of oil sand at 400 feet.

Clark & Sherman Land Co. At the point where the Sawtelle electric line swings to the north, on the east line of section 29, 1–14, this company has a group of nine wells, of which five are rigged on the jack but not operating, one is cased but not rigged, and three have been pulled.

These wells were drilled in 1899 and 1900, and range in depth from 120 feet to 521 feet. In four of these wells, oil was found at from 50 feet to 85 feet below the surface. One well was 460 feet deep, and found oil, which flowed over the casing, at 150 feet.

The well farthest to the north, just east of the ranch line, is on the jack; the next well to the south has been pulled, but shows signs of having made some rather heavy oil. The next well to the south of the latter, the last in this row, is also on the jack.

The well farthest to the northwest has been pulled, but is still flowing a little light oil, similar to that found farther south. The well due south of this has the casing in, and is flowing a small amount of oil, from the inner string. This oil is of a greenish-black color, gravity 21.6° Beaumé. The two wells southeast of this are on the jack.

In the southeast corner of the tract, inside the ranch line and close to the railroad, a well has been drilled, but there are no signs of oil around this location. Just north of this a well is on the jack. The lease has been partly stripped, and apparently has not operated for some time.

Ida Hancock tract. This strip is in the northwest quarter of sec-

tion 28, and on it there are four wells, one the Hardison well noted just below, and three others about which nothing is known.

The well farthest to the south, close to the electric line, appears to have been a dry hole. There is a large dump, but no signs of oil. The well next to the north, opposite the Clark wells, is full to the top of a heavy oil, but is not flowing. The well toward the center of the tract, opposite the Union's Massalin wells, is flowing a little heavy oil.

Hardison, McFarland & Stewart. This hole is located at the north end of the Hancock strip, just south of Wilshire boulevard, and southeast of the lagoon. It was drilled in 1885, and pulled out in the following year. It is said to have been 1780 feet deep, and to have been practically a dry hole.

Union Oil Company—Pitcher & Garbutt Oil Company—Massalin. The three wells near the center of the Massalin tract, northwest quarter of section 28, now belonging to the Union Oil Company, were drilled by the Pitcher & Garbutt Oil Company of Los Angeles. These wells were drilled in 1899 to 1901. Well No. 1 was 901 feet deep, but is said to have gotten most of its oil at about 40 feet. This well is seeping a little very heavy tar. Well No. 2, just to the east, is said to be 1083 feet deep. This well is reported to have gotten its oil at 951 feet. It is rigged with a hand pump (the casing appears to have been drawn) and the pit is full of a rather heavy oil. Well No. 3, the easternmost well of the string, was carried to a depth something in excess of 3100 feet, and got a small production of 20° gravity oil near the bottom. This well is still rigged, and is pumped occasionally, but the yield is very light.

In the southeast corner of the Massalin tract, near the electric line, is a location where some drilling has been done, but the casing has been drawn, and no oil is in evidence.

Union Oil Company—Brashear. At the southwest corner of the Brashear tract, just east of the Massalin property, are two abandoned holes, both of which show some oil.

The well to the northwest is full to the top with a very heavy tar, but is not flowing. The southeasterly well appears to have been pulled. There is a large square pit, which is full of oil of about 16° Beaumé. Gas is constantly bubbling up through this oil, keeping it rolling over, but no oil overflows. No information can be had as to the more northerly hole—the southern is the Rosemary location.

Union Oil Company—Rosemary. The Rosemary well of the Union Oil Company, by far the deepest hole in California, was drilled on the Brashear tract, and was abandoned in the year 1910. This remarkable hole was drilled with a standard rig, and reached a depth of 5594 feet. A little oil was found near the surface, and it is said that some oil, perhaps enough to make a small well, was found at the bottom of the hole.

There was, however, no quantity to be of value at such a depth. This hole was largely in shale, and gave very little trouble. When abandoned it had been reduced only to 4½ inches.

W. J. Variel tract. On the north line of this tract, just south of the Massalin, two holes have been started, though there is nothing to show how much depth was made. There are no signs of oil around these locations.

Joyce, T. R. On the south line of Wilshire boulevard, in the northwest corner of section 27, there are two wells belonging to Thomas R. Joyce, of Hollywood. These wells produce a small amount of very heavy oil, and are said to be of medium depth, somewhere about 1800 feet. When last visited they were rigged for pumping on the beam, but were not in operation.

Simon Mansfield tract. On this property in the northeast quarter of section 28 and the northwest quarter of section 27 are two abandoned wells about which nothing could be learned. They appear to have had some oil, but are now stripped.

Rommel Oil Company. Well No. 1 of this company is said to have been located on the Gay tract, No. 2 on the Rimpau tract, section 27. The locations given on the map are uncertain. Well No. 1 is said to have been 750 feet deep, and to have had oil from a depth of 75 feet to the bottom of the hole. This well flowed ten barrels per day of 25° gravity oil while drilling, but was abandoned. Well No. 2 is said to have been 1000 feet deep, and to have had a sixty-foot sand at 550 feet, yielding a 22° gravity oil. This well also is abandoned.

Rosedale Cemetery Association. On this tract, in the southeast quarter of section 28, there are five wells, about which the following data are given by Watts (Bulletin 29). "Well No. 1, 550 feet deep, 60 feet oil sand at bottom. Well No. 2, 800 feet deep, water, no oil. Well No. 3, 160 feet deep, 20 feet oil sand at bottom. Well No. 4, 160 feet deep, 30 feet oil sand at bottom.. Well No. 5, 120 feet deep, 66 feet oil sand." Two or three of these wells were pumped with a windmill for some time, but all are now abandoned. Two are still cased, and in these the oil stands close to the surface, but does not overflow. This is a medium heavy oil, about 16° Beaumé.

W. H. Mansfield tract. The wells on this tract lie close to the west line of section 33, but the location in a north and south direction is uncertain. Watts gives the following notes regarding these wells. "Well No. 1, 550 feet deep, 60 feet oil sand at bottom. Well No. 2, old gas well, gas burned many years in house. Well No. 3, 53 feet deep, 31 feet sand, gas in one inch pipe burning."

Thomas, H. C. Is said to have drilled two wells on the Crosswell

tract, in the southeast corner of section 32. Well No. 1 was 654 feet deep, and is said to have found oil sand from 45 feet to 160 feet. No. 2 was only 175 feet deep, but is reported to have penetrated oil sand for 138 feet.

Hauser tract. The wells on the property of the Hauser Packing Company are on the northwest quarter of section 33. Well No. 1 is said to have found sulfur water at 230 feet, No. 2 an artesian flow at 355 feet. Neither showed any oil.

Keating tract. Two wells were drilled on the property of the A. J. W. Keating estate, in the east half of section 33, and extending into the next township south.

Well No. 1 was located between Adams street and the Southern Pacific railroad, and is off the bounds of the map. This well was 1256 feet deep, penetrated strata of sand, sandstone and blue clay, and got traces of oil and gas somewhere about 1000 feet. Well No. 2 was about 500 feet deep, and had much water and some gas, but no oil.

Ivy Station well. A shallow well is said to have been drilled near Ivy station, on the Southern Pacific railroad. This well was 153 feet deep, and got a good showing of gas.

Wells in Beverly Hills.

A number of deep holes have been drilled in this range of hills, and some production obtained, but little information is available as to the final results of the work done. There are now nineteen producing wells, two drilling, and eight abandoned. There are also six abandoned wells at some distance from the main group, and two are said to be drilling.

Pacific Petroleum Company. This company has eleven wells, more or less productive, and is drilling two, on Wolfskill property, at the northeast corner of section 26, 1–15, on Rancho San José de Buenos Ayres. A few of the depths are known. Well No. 23 is 2745 feet deep, No. 36 is 2737 feet, No. 43 is 2845 feet, No. 49 is 2735 feet, and No. 59 is 2743 feet deep. These wells are all nominally producers, but had much trouble with water, and the output of some of them is quite small. The gravity of the oil is slightly better than 18° Beaumé.

Well No. 26, near the north line, and No. 82, near the south line, are now drilling, the latter being over 4200 feet deep, in January, 1912.

Amalgamated Oil Company—Rodeo Land & Water Company. This company has a string of twelve wells, just east of the Pacific Petroleum wells, on the west line of Rancho Rodeo de Las Aguas. The seven wells lying next to the ranch line are productive, the other five abandoned.

Amalgamated Oil Company—West Coast Oil Company—Gillis. On the Gillis tract, adjoining the Pacific Petroleum on the southwest, the West Coast has two wells, No. 1 being a producer at 2382 feet, and No. 10 said to be abandoned, at 3726 feet, a dry hole.

Greenlea Oil Company. This well is in the northeast corner of the J. Burkhardt tract, southwest corner section 21, 1–15. Abandoned.

Amalgamated Oil Company—Newmark & Edwards. This well is south of the Southern Pacific Railroad, southeast corner section 34, 1–15. Abandoned, at 2967 feet, a dry hole. This well is said to have been drilled entirely without casing.

Amalgamated Oil Company—Moon. This deep hole was drilled on the southwest corner of section 22, 1–15. It is said to have had some oil, but is abandoned.

Consolidated Petroleum Corporation. Drilled two wells on the tract west of the Country Club, one on the south line of section 14, the other on the north line of section 26, 1–15. Both abandoned.

Denker, A. H. On the southeast corner of section 12, 1–15 is a seepage of tar and a small brea deposit, and on this two wells were drilled in the year 1886 by A. H. Denker. One of these wells was 520 feet deep, the other near that depth. These wells were mainly in sandstone, with traces of tar at several levels. They are now flowing sulfur water, with some gas, and traces of oil.

Northwest Oil Company. Just to the southwest of the Denker wells, this company drilled a deeper hole during 1909. Abandoned.

Kansas Crude Oil Company. This company is drilling two wells north of the electric line, opposite Pacific Petroleum land. These wells were started in the year 1912.

QUALITIES OF SALT LAKE OILS.

The crudes of the Salt Lake field vary widely in gravity and in commercial analysis, but show marked similarity in general properties. All are characterized by a high percentage of sulfur, which varies irregularly, and bears no relation to the gravity of the oil. The heavy oils are distinguished by an unusually high viscosity, high even for the gravity, and in this respect approach the oils of Cat Cañon.

A characteristic of all grades is the high yield of asphalt and of light products for any given gravity. For instance, a Whittier oil of 20° Beaumé gives little or no engine-distillate, and no gasoline, while a Sale Lake oil of this gravity gives a good yield of gasoline. A City crude of 16° Beaumé gives no naphthas nor kerosene, but starts to distil in the stove-oil cut, while a Salt Lake crude of this gravity usually gives a large yield of kerosene, and often a little engine-distillate. The yield of asphalt is correspondingly high, being on the average nearly a half greater than from a City crude of the same gravity.

These valuable properties are offset, to some extent, by the high degree of impurity of the distillates from these oils. This impurity renders the heavy cuts of little value, though the contaminating bodies may be

removed from the lighter distillates by rigorous treatment. On the whole, the lighter grades of this crude are of much value for refining, considering the present demand for the naphthas.

7439.*

Rancho La Brea Oil Company. Well No. 14.

Gravity ---------- 10.0° Beaumé
Viscosity at 185° F. ---------- 97.83 Redwood

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 482° F.	4.0 per cent	31.9° Beaumé
482 to 572°	25.4 per cent	27.6°
572° to grade	22.0 per cent	21.5°
Asphalt	46.5 per cent	Grade "D" (about)
Loss	2.1 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	3.0 per cent
Middlings and lubricants	24.8°	48.4 per cent (not separated)
Asphalt	"D"	46.5 per cent, or 163.2 lbs. per bbl.
Loss	---	2.1 per cent
		100.0 per cent

6459.†

Rancho La Brea Oil Company. Well No. 42.

Gravity ---------- 11.3° Beaumé

This is a very thick, brownish-black oil, with a mild odor.

Distillation.

Sample of 200 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation carried to a residue of dry coke.

First cut	2.6 per cent	42.0° Beaumé
Second cut	9.1 per cent	32.7°
Third cut	73.2 per cent	18.2°
Fixed carbon	15.1 grams per 100 c.c.	
	100.0 per cent	

On reduction of the lubricating stock in a current of gas, and calculation of the residue to coke, the following commercial analysis is had:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	2.6 per cent
Stove oil	33°	8.5 per cent
Fuel distillate	29.6°	16.9 per cent / Slop distillate
Reduced stock	13.2°	34.2 per cent \ 18.2°—51.1%
Asphalt	"D"	37.8 per cent, or 132.7 lbs. per bbl.
		100.0 per cent

*Analysis by H. N. Cooper.
†Analysis by J. P. P.

The light products from this oil were of good color, but had a sharp and unpleasant odor, which did not disappear on treatment.

The lubricating stock also had a very pungent odor, which passed away on reduction. The reduced stock was of a rich green color, with high viscosity, and free from paraffin.

5404.*

Salt Lake Oil Company. Average Heavy Oil.

Gravity ---------- 12.5° Beaumé

This is a rather thick, black oil, with a strong but not sulfurous odor.

Distillation.

A sample of 200 c.c., distilled from copper in a current of inert gas. Distillation carried to a residue of dry coke.

First cut ----------	24.5 per cent	32.7° Beaumé
Second cut ----------	61.5 per cent	19.7°
Fixed carbon ----------	14.0 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the coke to "D" asphalt in the usual manner, we have the following commercial analysis:

Gasoline ----------	61° Beaumé	None
Engine distillate ----------	52°	None
Kerosene ----------	42°	5.0 per cent (estimated)
Stove oil ----------	33°	15.0 per cent
Fuel distillate ----------	29.5°	17.1 per cent / Slop distillate
Reduced stock ----------	14.3°	27.9 per cent \ 19.5°—45.0%
Asphalt ----------	"D"	35.0 per cent, or 122.8 lbs. per bbl.
		100.0 per cent

The first 10 per cent of distillate from this oil had the gravity 39.0° Beaumé, but the percentage given for kerosene is only approximate. The light cut had a very foul odor and a dark color, these being but little improved by the test treatment.

The lubricating stock was of good color and odor, and medium viscosity. It gave a reduced stock with a very rich green tone, pale color and medium viscosity, which treated out to a rather dark red oil of similar properties. This appears to be an excellent asphalt oil, and a satisfactory lubricating stock.

*Analysis by P. W. P.

5405.*

Arcturus Oil Company. Well No. 140.

Gravity ---------- 12.8° Beaumé

This is a rather thick black oil of a strong, sweetish odor, not sulfurous.

Distillation.

A sample of 300 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	9.8 per cent	41.7° Beaumé
Second cut	6.6 per cent	33.1°
Third cut	67.7 per cent	22.8°
Fixed carbon	15.9 grams per 100 c.c.	

100.0 per cent

On calculation of the carbon to asphalt, and reduction of the last cut in a current of gas, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	9.5 per cent
Stove oil	33°	7.0 per cent
Fuel distillate	30.2°	20.1 per cent / Slop distillate
Reduced stock	15.5°	23.6 per cent \ 22.8°—43.7%
Asphalt	"D"	39.8 per cent, or 139.7 lbs. per bbl.

100.0 per cent

Differing from the rule with these oils, the distillates from this crude were not sulfurous. The light products, however, were very dark, and were not improved much by the test treatment.

6461.*

Arcturus Oil Company. Well No. 132.

Gravity ---------- 13.4° Beaumé

This sample is from one of the wells at the western extremity of the field, close to the fault which terminates the productive territory in this direction. It is a thick, black oil of mild odor.

Distillation.

Sample of 200 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	6.3 per cent	40.7° Beaumé
Second cut	11.0 per cent	30.5°
Third cut	69.7 per cent	19.1°
Fixed carbon	13.0 grams per 100 c.c.	

100.0 per cent

*Analysis by J. P. P.

On reduction of the last cut in a current of gas, and calculation of the residue to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	4.5 per cent
Stove oil	33°	11.5 per cent
Fuel distillate	30.1°	24.2 per cent) Slop distillate
Reduced stock	13.6°	27.3 per cent) 19.1°—51.5%
Asphalt	"D"	32.5 per cent, or 114.1 lbs. per bbl.
		100.0 per cent

The kerosene from this oil ran quite dark in color, with a sharp odor, but treated out readily to a white and sweet oil. The stove oil was also dark, with a strong sulfurous odor, which gave place to a sweet odor and fair color on treatment.

The reduced stock had a normal color and viscosity, but showed some paraffin crystallization at 75° F.

6464.*

Rancho La Brea Oil Company. Well No. 27.

Gravity ---------- 13.6° Beaumé

This is a rather thick, very black oil, with a rather strong, sweetish odor.

Distillation.

Sample of 200 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	8.5 per cent	41.1° Beaumé
Second cut	17.8 per cent	31.2°
Third cut	55.9 per cent	20.7°
Fixed carbon	17.8 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	8.0 per cent
Stove oil	33°	16.0 per cent
Fuel distillate	30.2°	10.1 per cent) Slop distillate
Reduced stock	14.8°	21.4 per cent) 20.7°—31.5%
Asphalt	"D"	44.5 per cent, or 156.2 lbs. per bbl.
		100.0 per cent

The kerosene from this crude ran dark colored, but with a mild odor, and treated out to a water-white and very sweet oil. The stove oil, however, was badly burned and contained much sulfur, and did not sweeten in the treatment.

The lubricating stock was pale and bright green, but contained considerable sulfur and darkened in reduction, giving a reduced stock of only fair color, with a rather high viscosity, and free from paraffin.

*Analysis by J. P. P.

5402.*

Arcturus Oil Company. Average Heavy Oil.

Gravity ..... 16.6° Beaumé

This is a rather thin, black oil, of a mild, sweet odor, not sulfurous.

Distillation.

A sample of 250 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	17.1 per cent	42.0° Beaumé
Second cut	8.5 per cent	30.1°
Third cut	60.8 per cent	23.8°
Fixed carbon	14.2 grams per 100 c.c.	
	100.0 per cent	

On calculation of the fixed carbon to asphalt, and reduction of the last cut in a current of gas, these figures give the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	Trace
Kerosene	42°	17.1 per cent
Stove oil	33°	6.0 per cent
Fuel distillate	28.5°	27.3 per cent / Slop distillate
Reduced stock	15.1°	14.1 per cent \ 23.8°—41.4%
Asphalt	"D"	35.5 per cent, or 124.6 lbs. per bbl.
		100.0 per cent

The first 5 per cent of distillate had the gravity 49.7°, and it is probable that on a larger scale this oil would run 1 per cent to 2 per cent engine distillate, with a corresponding decrease on the kerosene. The kerosene cut, as it came from the still, was dark colored and rank, and treated out fairly well only, though it is quite possible to treat out these oils to water white and sweet products, by a more rigorous treatment than this standard test treatment.

The lubricating stock came from the still with a good color, rather low viscosity, and a very rank odor. It gave a good sweet reduced stock, with a rich green color, good viscosity, and a slight crystallization. This treated out to a dark-red engine oil with a full green tone, of medium viscosity.

*Analysis by P. W. P.

7438.*

Salt Lake Oil Company. Well No. 4.

Gravity	17.6° Beaumé
Viscosity at 60° F.	78.63 Redwood
Viscosity at 185° F.	2.83 Redwood
Flash point	Below 60° F., Abel–Pensky test

Distillation.

Sample of 200 c.c., distilled from a glass flask without either steam or gas.

Below 212° F.	2.9 per cent	63.2° Beaumé
212 to 302°	7.9 per cent	53.0°
302 to 392°	7.4 per cent	41.2°
392 to 482°	7.8 per cent	29.0°
482 to 572°	17.0 per cent	27.3°
572° to grade—a	18.2 per cent	24.7°
572° to grade—b	11.5 per cent	27.2°
Asphalt	26.8 per cent	Grade "D" (about)
Loss	0.5 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	4.0 per cent
Engine distillate	52°	6.8 per cent
Kerosene	42°	6.5 per cent
Stove oil	33°	4.0 per cent
Middlings and lubricants	26.4°	51.4 per cent (not separated)
Asphalt	"D"	26.8 per cent, or 94.1 lbs. per bbl.
Loss	---	0.5 per cent
		100.0 per cent

5401.†

Pacific Petroleum Company. Lease average.

Gravity	18.3° Beaumé

This is a moderately limpid, very black oil, of a rank, sulfurous and penetrating odor.

This crude contained 1.71 per cent by weight of sulfur. Some figures as to the layout of the sulfur compounds in the various fractions of this oil are given in Chapter 22.

Distillation.

A sample of 150 c.c., distilled from copper in a current of inert gas. Distillation carried to dry coke.

First cut	7.8 per cent	48.6° Beaumé
Second cut	11.5 per cent	36.9°
Third cut	13.5 per cent	30.7°
Fourth cut	55.3 per cent	20.8°
Fixed carbon	11.9 grams per 100 c.c.	
	100.0 per cent	

*Analysis by H. N. Cooper.

†Analysis by J. P. P.

The lubricating stock was not reduced. On calculation of the coke to asphalt, these figures are equivalent to the following partial commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	3.0 per cent
Kerosene	42°	12.0 per cent
Stove oil	33°	18.0 per cent
Middlings and lubricants	20.8°	39.8 per cent (not separated)
Asphalt	"D"	27.2 per cent, or 95.5 lbs. per bbl.
		100.0 per cent

6466.*

Salt Lake Oil Company. Well No. 31.

Gravity ..... 19.3° Beaumé

This is a rather limpid, brownish oil, with a strong and unpleasant odor.

Distillation.

Sample of 200 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation carried to a residue of dry coke.

First cut	9.0 per cent	60.7° Beaumé
Second cut	4.8 per cent	51.8°
Third cut	8.1 per cent	41.9°
Fourth cut	8.1 per cent	32.6°
Fifth cut	63.5 per cent	19.1°
Fixed carbon	6.5 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the residue to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	9.0 per cent	
Engine distillate	52°	4.5 per cent	
Kerosene	42°	8.4 per cent	
Stove oil	33°	7.5 per cent	
Fuel distillate	29.7°	24.4 per cent	Slop distillate
Reduced stock	14.4°	32.4 per cent	19.1°—56.8%
Asphalt	"D"	13.8 per cent, or 48.4 lbs. per bbl.	
		100.0 per cent	

The light products from this oil ran pale and sweet, and treated out readily to products of the best quality. The lubricating stock was rank with hydrogen sulfid, but sweetened in reduction, and gave a reduced stock of normal properties and containing a little paraffin.

The low percentage of asphalt from this oil is unusual for this field, which, however, is characterized by the wide variations in properties of oils of similar appearance.

*Analysis by J. P. P.

6453.*

Gilmore Oil Company. Well No. 47.

Gravity ---------- 21.5° Beaumé

This is a moderately limpid, brownish-black oil, with a strong and unpleasant but not sulfurous odor.

Distillation.

Sample of 300 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	15.5 per cent	51.7° Beaumé
Second cut	10.0 per cent	38.3°
Third cut	8.2 per cent	33.0°
Fourth cut	55.3 per cent	25.3°
Fixed carbon	11.0 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	15.0 per cent
Kerosene	42°	7.0 per cent
Stove oil	33°	15.0 per cent
Fuel distillate	30.5°	23.8 per cent } Slop distillate
Reduced stock	15.7°	11.7 per cent } 25.3°—35.5%
Asphalt	"D"	27.5 per cent, or 96.5 lbs. per bbl.
		100.0 per cent

The light products from this oil ran very dark colored from the still, but treated out to a very mild odor and fair color. The stove oil was very strong with sulfur, and burned badly.

The lubricating stock also contained much sulfur, and was of low viscosity, though the color was good. On reduction the viscosity was still below normal, and a trace of paraffin appeared, which did not show in the distillate.

5414.*

Pitcher & Garbutt Oil Company. Well No. 2.

Gravity ---------- 14.6° Beaumé

This sample is from one of the old wells south of Wilshire boulevard. The well is pumped occasionally, and the oil appears to be fresh.

Distillation.

Sample of 110 c.c., distilled from copper in a current of gas. Distillation carried to a residue of dry coke.

First cut	16.9 per cent	33.0° Beaumé
Second cut	73.1 per cent	19.9°
Fixed carbon	10.0 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

On reduction of the last cut in a stream of gas, and calculation of the carbon to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	2.0 per cent (approximate)
Stove oil	33°	29.0 per cent
Fuel distillate	29.3°	21.6 per cent / Slop distillate
Reduced stock	12.3°	22.4 per cent \ 19.9°—44.0%
Asphalt	"D"	25.0 per cent, or 87.8 lbs. per bbl.
		100.0 per cent

The stove oil ran very dark, rank and sulfurous, but cleared up to a red color and fair odor on treatment. The lubricating stock was of good color and viscosity, and gave a dark reduced stock, of high viscosity, and showing some tendency to crystallize.

6465.*

Rosedale Cemetery Well.

Gravity ---------- 15.5° Beaumé

This is a brownish-black oil, of moderate viscosity, and with a mild odor. The sample was taken from one of the wells on the southeast quarter of section 28, just north of the Sawtelle electric line. This well is full to the top and overflowing slightly, and the fresh oil from below is constantly brought to the surface by the flow of gas. The sample, however, is probably somewhat depreciated.

Distillation.

A sample of 250 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	4.8 per cent	51.7° Beaumé
Second cut	10.3 per cent	41.7°
Third cut	7.0 per cent	31.3°
Fourth cut	66.9 per cent	18.6°
Fixed carbon	11.0 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	4.5 per cent
Kerosene	42°	10.5 per cent
Stove oil	33°	5.0 per cent
Fuel distillate	29.8°	20.6 per cent / Slop distillate
Reduced stock	14.0°	41.9 per cent \ 18.6°—62.5%
Asphalt	"D"	17.5 per cent, or 61.4 lbs. per bbl.
		100.0 per cent

The light products from this crude very much resemble those from the Clark & Sherman well (6462) in running dark and foul from the still, and in treating out readily to products of the best quality. The stove oil from this crude, however, was much sweeter than that from 6462.

*Analysis by J. P. P.

The lubricating stock had a sulfurous odor, but the reduced stock was sweet, of medium color and rather low viscosity. It showed no evidences of paraffin.

6467.*

Pitcher & Garbutt. Well No. 3.

Gravity ..... 16.7° Beaumé

This sample is from one of the wells just south of Wilshire boulevard, and near or in the south fault line. It is an oil of medium viscosity, brown color and strong unpleasant odor.

Distillation.

Sample of 200 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	2.3 per cent	42.0° Beaumé
Second cut	11.5 per cent	33.0°
Third cut	77.4 per cent	20.9°
Fixed carbon	8.8 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, the following commercial analysis is had:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	2.3 per cent
Stove oil	33°	11.5 per cent
Fuel distillate	30.0°	21.8 per cent / Slop distillate
Reduced stock	15.8°	42.4 per cent) 20.9°—64.2%
Asphalt	"D"	22.0 per cent. or 77.2 lbs. per bbl.
		100.0 per cent

The light products from this oil ran yellow, and had a strong sulfurous odor. This was removed by treatment, but the odor was still not of the best.

The reduced stock was of excellent color, and of high viscosity, but separates a little paraffin.

6462.*

Clark & Sherman Land Company. A well.

Gravity ..... 21.1° Beaumé

This sample was taken from one of the wells near Hauser Station, south of Wilshire boulevard. The well was flowing slowly from the inner casing, which was capped, thereby protecting the oil against evaporation.

This is a limpid, brownish oil, with a strong and rather pungent odor.

Distillation.

Sample of 300 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	14.4 per cent	60.9° Beaumé
Second cut	14.0 per cent	41.8°
Third cut	6.5 per cent	30.4°
Fourth cut	56.3 per cent	17.7°
Fixed carbon	8.8 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	14.0 per cent
Engine distillate	52°	None
Kerosene	42°	14.0 per cent
Stove oil	33°	4.0 per cent
Fuel distillate	27.4°	16.1 per cent / Slop distillate
Reduced stock	13.9°	29.9 per cent \ 17.7°—46.0%
Asphalt	"D"	22.0 per cent, or 77.2 lbs. per bbl.
		100.0 per cent

The gasoline from this crude ran somewhat off color, and only fairly sweet, but gave with the test acid a strictly water-white naphtha, with a sweet and ethereal odor.

The kerosene was peculiar in running very dark colored, with a green outer tone and a rank odor, and in treating out with the usual test acid to a strictly water-white oil, very mild and sweet. The stove oil, however, which showed the same characteristics as it came from the still, did not take treatment well, and retained a penetrating smell of onions, due to the presence of sulfur compounds.

The lubricating stock was of medium viscosity and color, as was the reduced stock. The latter showed a little crystallization at 75° F.

5410.*

Clark Oil Company. Hauser Station.

Gravity ..... 22.6° Beaumé

This sample is from one of the old abandoned wells on the lease just north of the Sawtelle electric line. The well is flowing slowly from the inner casing, and the oil may be somewhat debased, though the analysis would not indicate this to be the case.

Distillation.

A sample of 150 c.c. was distilled from copper, first four cuts dry, last cut in a current of inert gas. Distillation carried to a residue of dry coke.

First cut	11.3 per cent	61.9° Beaumé
Second cut	5.6 per cent	52.0°
Third cut	9.1 per cent	40.6°
Fourth cut	8.5 per cent	30.6°
Fifth cut	58.5 per cent	19.5°
Fixed carbon	7.0 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

On calculation of the coke to asphalt in the usual manner, and reduction of the last cut in a stream of inert gas, the following commercial analysis is obtained:

Gasoline	61° Beaumé	13.0 per cent
Engine distillate	52°	4.0 per cent
Kerosene	42°	10.0 per cent
Stove oil	33°	7.0 per cent
Fuel distillate	29.4°	11.1 per cent } Slop distillate
Reduced stock	15.3°	37.4 per cent } 19.5°—48.5%
Asphalt	"D"	17.5 per cent, or 61.4 lbs. per bbl.
		100.0 per cent

The light products from this crude came over only fairly light in color, and not very sweet, but took the acid readily, and treated out to good colors and odors. The heavy end of the oil was of good color and low viscosity, and gave a reduced stock which treated out to a rather dull engine oil, of 16.7° Beaumé gravity, and moderate viscosity. There are no indications of paraffin, and on the whole this oil handles very well, better than the average oil of the same gravity from farther north in the field.

CHAPTER XIII.

PUENTE HILLS GROUP.

The Puente hills divide Chino Valley from La Habra Valley, and are separated from the Rapetto hills, which pass through the northern part of the city of Los Angeles, by the narrow valley of San Gabriel River. The oil producing territory lying along this range and in the valley to its south has been known under a confusing variety of names, taken from local topographic features, and the titles Whittier, Puente, La Habra, Coyote Hills, Brea Cañon, Olinda and Fullerton, are all comprised within the limits of the map here shown. (See Whittier-Olinda field map.)

The title Whittier, taken from the charming little town of that name, applies to the western end of the field, and extending eastward to the limits of the Central and Murphy properties in sections 23 and 26. The name La Habra was originally applied to certain developments just to the east, in a small spur known as La Habra Hills, but has now been extended to cover the whole of the La Habra Valley, along the southern limit of which oil is now being developed. Puente is the name usually applied to a group of wells located on the southeast corner of the Rancho Puente, and north of the mouth of Brea Cañon. The latter name is applied to a group of wells closely adjacent to the Puente wells, but geologically separated, lying along and mainly south of Brea Cañon. The name Fullerton was borrowed from a town several miles south, but has in ordinary usage given place to the title Olinda, the railroad name for the little oil town at the terminus of the Santa Fé branch line. These two names apply to all the territory lying east of the Brea Cañon wells, the dividing line being indeterminate. The name Coyote Hills, or briefly Coyote, is taken from a group of low hills dividing La Habra Valley from the Los Angeles plain. It applies solely to a cluster of nine or ten wells, lying in these hills, the wells being often included under the general name, La Habra.

The compound name Whittier-Olinda is perhaps most commonly used to designate this field as a whole. The arrangement of the minor names is indicated on the field map, Whittier being the most westerly portion of the hill territory, Puente and Brea Cañon the central portion, and Fullerton or Olinda the eastern, while La Habra is the whole valley strip lying south of these divisions, and Coyote a small hilly portion of the La Habra territory.

Topography and Climate. The topography of this field is simple, and may be dismissed with a word. The Puentes are a range of striking and beautiful appearance, of steep but not rugged hills, rounded like all the

mountains in this soft formation, and grass covered. The main cañons, La Habra, Soquel, Brea, and Telegraph, are of greater age, apparently, than the hills, which they penetrate in a generally southwesterly direction, and being the result of superimposed erosion. The minor cañons follow the present trend of the surface formations, and have no consistent direction.

These hills lie in a line very nearly straight, and bearing about S. 65° E., and the Coyote hills have the same general direction, the La Habra Valley lying between these two ranges. This valley has a floor some two or three miles in width and almost level, rising but slightly at its margins and to the east. Where protected by Coyote hills, this valley is a continuous grove of oranges, lemons and walnuts, of surprising beauty and productiveness, but farther east is just coming to intensive cultivation, having been largely devoted to grain.

The climate of the whole of this section is most agreeable, being mild and free from frost in winter, with a moderate but sufficient rainfall, and with no excessive heat in summer.

Means of Transportation. In this respect this district is unusually favored. A good county road paralleling the hills at close range, and others at greater distances, are intersected by many crossroads, three of which penetrate the hills into Chino Valley.

As to railroads, the Pacific Electric has a line from Los Angeles to Whittier, coming in from the southwest, and a branch from Los Nietos runs along the center of La Habra Valley, at an average distance of two miles south of the principal groups of wells. The Southern Pacific enters the town of Whittier from the southeast, and the Santa Fé terminates a branch at Olinda, in the midst of the eastern group of wells.

Pipe lines of the Union Oil Company, the Associated Oil Company and the Standard Oil Company reach all parts of the field. The Murphy and Central Oil companies have independent lines reaching Los Nietos on the Southern Pacific, and the Puente Oil Company pipes its own oil to its refinery at Chino.

Whittier Field.

Structure. The structure of the Whittier oil field is sharply distinguished from that of other fields of California, in that oil is here produced along, and indeed in, zones of much displacement and fracturing, and in very steeply inclined strata. Superficially this may seem to be the same condition encountered along the Pico-Wiley fault in Newhall, but in the latter case the location of the productive strip does not, as in Whittier, depend on the presence of the fault, but on the contrary the wells drilled into this fault zone at Newhall have uniformly proven very small producers, or quite unproductive.

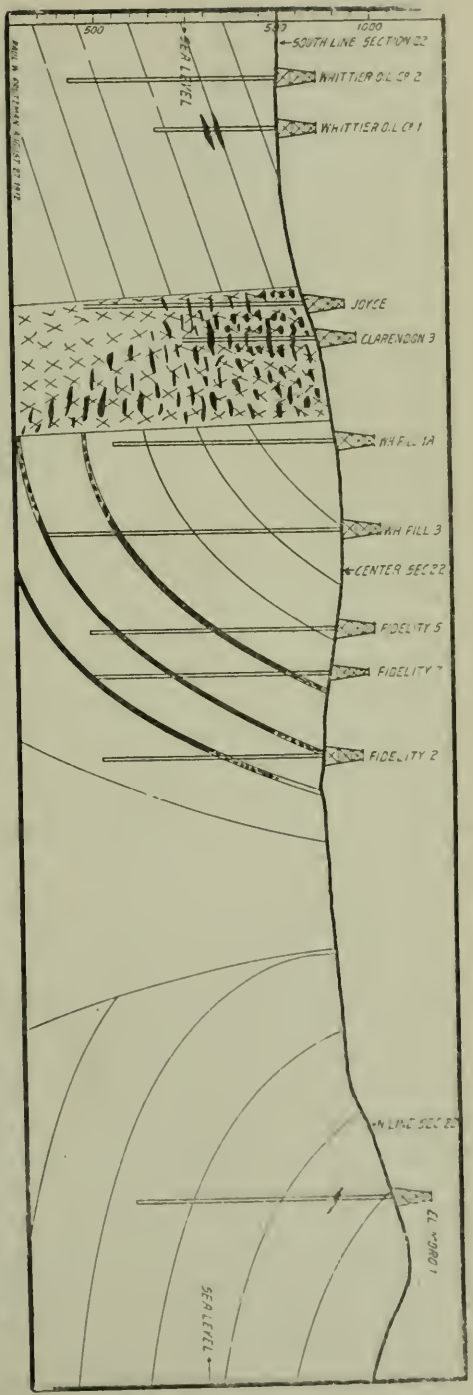
Town of Whittier; from Commonwealth Lease.

North-dipping Strata North Slope of Whittier Main Anticline.

Without going into details as to age and character of formation, which would be misplaced in this brief report, it may be said that a strip of territory extending from section 16, 2–11 to section 6, 3–9, consists of one or more very sharply compressed folds, considerably faulted, and with upturned edges. The section in Figure 29 will illustrate this manner of folding better than written description.

In the zone of crushing intermediate between the limbs of this fold or fault, the seepages were found through which this field was originally discovered. These seepages have, as is often the case, disappeared since a number of wells were drilled.

At the northwestern end of the main fold the unbroken formation of the north limb bends to the west and southwest, cutting off the extension of the south limb, which either terminates here or plunges beneath the surrounding strata. This termination of the south limb coincides in position with the unnamed cañon lying northwest of Turnbull Cañon, but from the exposures at this point it is impossible to determine whether the steep west side of this cañon is a fault scarp or is due to erosion along the upturned edges of the upper strata. However this may be, there is hardly a doubt that any possible extension of the producing sands of the south limb ceases at or just east of this line.



The earlier wells were, as usual, drilled along the zones of crushing, immediately adjacent to seepages, and while most of them found some heavy oil, none were commercially productive. As soon, however, as drilling was carried far enough to the south and west to reach the steeply inclined strata of the south dip, productive wells were had, and development thereafter proceeded along a narrow strip running northwest by southeast, until a strip perhaps two miles in length, and varying from one eighth to one half mile in width, had been demonstrated.

The nature of these developments, and the deductions to be drawn from them, follow:

Whittier Consolidated Oil Company. The wells of this company, on the southwest quarter of section 16, 2–11, were drilled in 1901, to depths of 300 feet and 1000 feet, respectively. Well No. 1 was a crooked hole. No. 2 is said to have been abandoned because of running sand and boulders, and to have found a little light oil. The latter portion of this statement is open to some doubt, as the surface indications are strongly to the effect that this well was located in a zone of excessive fracturing. If true, it would indicate a probability of the shales of the north limb carrying oil at depth.

North Whittier Oil Company. The two wells of this company, on the Hellman tract, northeast quarter of section 16, 2–11, were drilled in 1901 and 1902. Well No. 1 was a pointed hole at 1100 feet. Well No. 2 was drilled to 1530 feet, where it collapsed. These wells are both reported to have had some oil, and examination of the old locations shows that considerable oil, probably heavy, must have been baled out. These wells were located in the steeply inclined strata at the upper edge of the northwest dip, and the sands reached at the depth noted must lie very much deeper a short distance farther west.

Commonwealth Oil Company. The well of this company, located just south of the foregoing, was drilled in 1903 to a depth of 1170 feet, and abandoned because of a long succession of troubles, beginning with the collapsing of the 4½-inch casing at the bottom of the hole, and ending with the burning of the rig. This well actually pumped two barrels of oil per day, for a short time, as reported on what seems to be good authority. No sample of the oil can be found, but it is said to have been of about 20° Beaumé. The lack of a sample is unfortunate, as examination of a sample of this oil would have thrown light on the probable identity of the sands from which it was drawn. This well was located farther back on the formation than the North Whittier wells, and reached a much lower level. The sands passed in this well outcrop on the face of the hill just below, and are fine grained, fairly hard, and rather dry on the surface.

From these results it would appear that there is a possibility of devel-

oping a narrow strip of production along a line running west by a few degrees south from these wells. No data are available to show how far to the west this strip might extend, but on account of the extreme inclination of these strata, approaching the vertical at some points, no great width in a north and south direction would be possible, unless the overlying layers were also bituminized, of which there is no indication in the way of seepage or outcrop.

In this connection, the results from certain wells drilled to the east of the above are of interest.

Central Oil Company—Section 15. Most of the work of this company has been done in sections 22 and 23, on the south dip, but two wells were drilled on north-dipping formation. These were near the center of section 15, and something less than one half mile east of the North Whittier and Commonwealth wells.

Well No. 47 of the Central Oil Company was abandoned at a moderate depth because of mechanical troubles. No. 49 was then started close to the old location, and was carried to a depth said to have been in excess of 3100 feet. This well has not been worked on for some time, but was still rigged when last visited. No oil is known to have been encountered, and this is verified by the appearance of the rig.

This is very remarkable, as the location of this well is directly on the line of strike from the wells of the North Whittier, both of which, beyond any question, produced some oil. Three possibilities exist here: one, that the dip of the strata at this particular point approaches the vertical so nearly that, even at this depth, the sands touched in the North Whittier wells were not yet reached—the outcrops are practically on end, but this is often misleading. A second is that, by reason of water from above, the small amount of oil sand found in the two wells above mentioned might have been passed without notice. This is possible, but unlikely. The third is that the sands found in the North Whittier wells either pinched or became non-productive at some point in the intervening half-mile or less. As the surface formation is very regular, and there are absolutely no indications of cross-faulting, it is highly probable that the first suggestion is the correct one. If this be the case, there is a chance for the development of a strip running east from the North Whittier wells to a point somewhat south of the Central wells, and thence probably southeast. This must, however, be considered a possibility only.

El Moro Oil Company. The two wells of this company on the Hunt & Bailey tract, southwest quarter of the southwest quarter of section 14, 2–11, were drilled in 1901. Well No. 1 is reported to have gotten some gas and traces of heavy oil at some 300 feet, and to have been carried to a total depth of 1395 feet without any further discovery. Well No. 2

was a dry hole at 1200 feet. These wells are in the fault zone, or at the extreme south edge of the north dip—probably the latter.

Palo Solo Oil Company. The two wells drilled by this company are the farthest west of any which are certainly on the south dip. The first was a spoiled hole at 300 feet, the second was abandoned at 820 feet. These wells were drilled in 1901.

Collins, Isaac. In 1904 a hole was drilled slightly to the northeast of the above by Mr. Isaac Collins, of Whittier. This hole was carried to a depth of 880 feet, and abandoned because of collapsed casing. No oil was found in this nor in either of the Palo Solo wells, though at the slight depth reached but little is indicated as to the possibilities in this direction.

Pickering Land and Water Company. The three wells on the northwest forty of section 22, 2–11 were drilled at an early date, probably by the company named. No information as to these wells is now available, but they are probably very shallow.

Home Oil Company of Whittier. The first well of this company was drilled in 1899, on the Hillside Land Company tract, southwest quarter, northwest quarter of section 22. This well was 940 feet deep, and after penetrating four water-sands and finding no oil, was abandoned.

Thereafter operations were confined to the present holdings, a tract on the line between the northwest and northeast quarters. Here 20 wells have been drilled, of which 14 are producing, 5 abandoned, and one drilling.

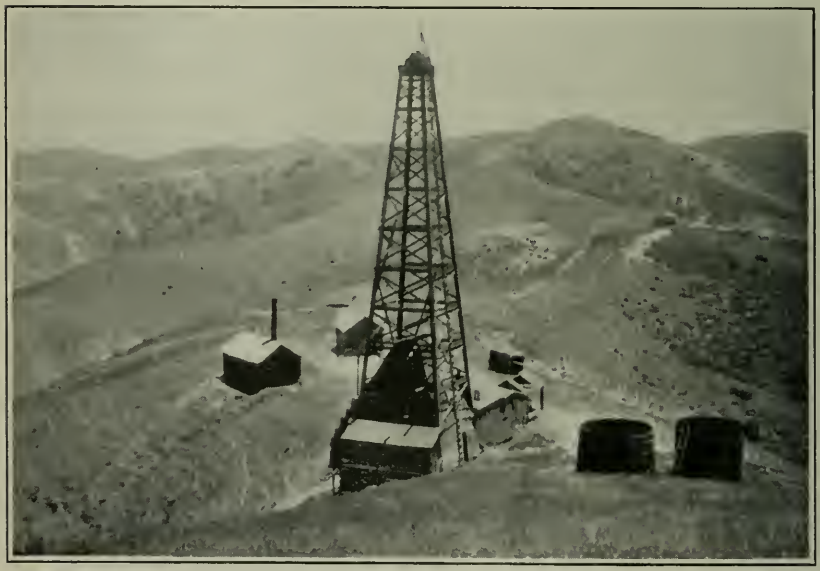
Well No. 1*a* was drilled in 1899 to a depth of 950 feet. This well was at the extreme northeast corner of the tract, and with the exception of Fidelity No. 2 is probably farther back on the formation than any other well on the section. Considerable water was found in this hole, but no oil, and it was abandoned.

No. 1*b* was located some distance to the southwest of the preceding, and abandoned at 600 feet. This well had some oil, but difficulty was found in cutting off upper water.

The wells from No. 2 to No. 9 are all producers at depths ranging from 1300 to 1600 feet, and make from 5 to 25 barrels per day each. No. 10, the farthest to the northwest, was abandoned at 1400 feet, with some oil, but not enough to make a profitable producer. The reason for this condition at this location is not apparent. No. 13 was pinched at 1300 feet, and abandoned before reaching a sufficient depth. No. 17 was abandoned at 1000 feet because of casing trouble. Numbers 11, 12, 14, 15, and 16 are producers at depths ranging from 1172 feet to 1715 feet, and range from 5 to 10 barrels per day output.

Well No. 18 was carried to a somewhat greater depth than any of the

Whittier Crude and Home Wells, Whittier Oil Field, Los Angeles County.



Central No. 49, on Apex of Whittier Anticline.

foregoing, being finished at 1820 feet. This is a larger producer than the average for this lease.

In Well No. 19 an effort was made to find a lower sand, and this was successful, as at 2412 feet this well had, it is said, 138 feet of productive sand. Difficulty was found in holding back upper water, and the hole was finally flooded and abandoned. No. 20 has now reached a depth of about 3900 feet (April, 1912), and is still being carried down.

The oil produced from this lease is quite uniform, ranging from 18° to 20° gravity, and appears to all come from one set of sands, if we except the output from well No. 19. Some water is produced with the oil, but this appears to be upper water, and there are no indications of water trouble in the usual sense. Water settles readily, on standing, from all the oils of this field. Drilling requires care, because of the steep pitch of the formation, which, however, stands up well, and gives little trouble from shifting.

Whittier Crude Oil Company. The first well of this company was drilled in 1898, and was a producer. Drilling has continued at intervals since, and there are now 13 wells, of which 11 are producers and 2 abandoned. The depths of the producing wells vary from 1000 to 2000 feet, and the daily output per well from 3 barrels to 12 barrels. Of the two abandoned wells, No. 6 was carried down to 1870 feet, which is below the level of the wells around it. Very little oil was found in this hole, and the water could not be handled. No. 11 was drilled to 1970 feet, and found no oil. It is far south of the other wells on this lease, and appears to have been too far down the dip to have found the sands at this depth. The remarks as to drilling conditions and quality of oil on the Home lease apply also to the Whittier Crude.

Colorado Oil Company—Turner Oil Company. On the 20-acre tract east of the Home tract, the first drilling was done in the year 1900, by the Turner Oil Company. Ten wells were drilled by this company, all of which are still producing. In 1910 this property was sold to the Colorado Oil Company, which drilled No. 11.

Wells Nos. 1 to 6 are from 1200 to 1500 feet deep, and are small producers. Commencing with No. 7, greater depth has been the rule, varying from 1804 feet to 2165 feet, and the wells have been considerably more productive, running up in one case to as much as 95 barrels per day from a single well. Well No. 11 was but lately finished, and is pumping from about 2400 feet. This is said to have reached the lower sand found in Home No. 19, and to be an excellent producer. All the wells on this lease are productive. The quality of the oil is similar to that of the Home wells.

Colorado Oil Company—Whittier Fillmore Oil Company. On the 20-acre tract described as the north half of the northwest quarter of the

southeast quarter of section 22, 3–11, the first well, marked "A" on the map, was drilled in 1898 by Tubbs & Evans. This was a crooked hole at 1200 feet. Later the property passed to the Whittier Fillmore Oil Company, that had previously done some unsuccessful prospecting at Fillmore, in Ventura county. The first hole drilled by this company was a producer at 2320 feet, and is now pumping. Well No. 2*a* was drilled to 2350 feet, but was abandoned on account of water. In 1909 this property was sold to the Colorado Oil Company, which has since drilled No. 3, a producer, at 1950 feet, and No. 4, a producer, at about 2400 feet, and is still drilling on No. 2*b*.

In spite of the fact that these wells get their oil at depths corresponding to the dip found farther north, and apparently produce from the same formation as the Home, Turner, and Fidelity wells, the oil from this lease is very much heavier, being of about 14° gravity, but corresponding closely with the lighter oils in chemical characteristics. These facts, taken in connection with the shallow oil found on the Joyce and Strong properties just south, seem to indicate a fault or minor fold, paralleling the main fold, and crossing the south line of the Whittier–Fillmore tract. This would also account, in part at least, for the unusual amount of upper water encountered in this immediate locality.

Whittier Oil Company. In the year 1897 the Whittier Oil Company drilled two wells on the southeast quarter of the southwest quarter of section 22. Well No. 1 was 660 feet deep, and found a streak of dry oil sand between 300 and 400 feet, but well No. 2, which was carried to a depth of 1125 feet, is said to have been in uninterrupted sandy shale from the 130-foot level to the bottom. These wells were abandoned because of water.

McCray Bros. Oil Company. Further north on the same section, the McCray Bros. Oil Company drilled two wells in the year 1900. The first was a lost hole at 400 feet, the second went to 1200 feet without finding any oil.

Anchor Petroleum Company. This company is now drilling a test hole near the old Whittier wells, but at last reports had not reached a sufficient depth to give any indication.

Thomas Joyce. On the 10-acre tract just east of the old McCray wells, Thomas Joyce drilled a 1200-foot hole, in the year 1900. Very little information can be had as to this well, but it is reported to have found a little heavy oil.

Clarendon Heights Oil Company. On the 10-acre tract of Mrs. H. R. Strong, east of the Joyce tract, this company drilled three wells in 1899, 1900, and 1901. The first two were carried to 252 feet and 336 feet, respectively, and both got a fair showing of oil. The third was 720 feet

deep, and found enough heavy oil to produce on the pump, though not enough for profitable operation.

Lying immediately south of 2000-foot territory, these shallow holes seem to indicate a change in the formation, but whether a fold or fault, by which the sands are brought closer to the surface, or a cap of overlying sands, can not be determined from the slender data at hand. If the shallow oil on the Strong tract is from the outcrop of an overlying sand, it would indicate that quite a strip of territory southwest of the wells now drilled, and on which the lower sands would lie very deep, might be productive. It is more likely, however, considering the abrupt change in character of the oil on the Whittier–Fillmore lease, that the Strong, Joyce, and McCray wells were drilled in a fault zone, and found their oil in stray sands drawing their oil from the producing sands on the north.

Warner Oil Company. On the southeast forty of section 22, 3–11, the Warner Oil Company has drilled eleven wells, beginning in the year 1899. Of these, all but No. 7, which was a lost hole at 1752 feet, have been producers. No. 3, however, at 915 feet, entered only the top of the sand; No. 8, after being brought to production at 2206 feet, was lost by the entry of upper water; No. 11 has lately been put to pumping at 2273 feet, and No. 12 is drilling.

The depths of these wells run in two groups, from 1050 to 1100 feet, and from 1650 to 1700 feet, other than as above stated. The quality of the oil is intermediate between that of the Home and of the Whittier-Fillmore.

Canadian Pacific Oil Company—Fidelity Oil Company. On the 20-acre tract east of the Turner the first well was drilled by the Fidelity Oil Company of Los Angeles, in 1900. This was a producer at 1400 feet. No. 2, a short distance to the north, was carried to 1200 feet and had some oil, but not enough to produce, and was abandoned. This well passed through the sands which produce to the southwest, and seems to have been too far back on the formation. Wells Nos. 3 to 8 were drilled by the Fidelity Oil Company, but in 1907 the property was sold to the Canadian Pacific Oil Company, that has drilled up to and including No. 12. These wells are all producers, with the exception of No. 2. The depths increase to the southwest, to a maximum of 2300 feet. The quality of the oil is much the same as that of the Home wells.

Canadian Pacific Oil Company—Savage. This company lately finished and abandoned a well on the Savage forty, the southwest quarter of the southeast quarter of section 22. The history of this well is not known.

Central Oil Company; Sections 22 and 23. The Central Oil Company of Los Angeles owns all of section 23, with the exception of the

10-acre Bulla tract, and a narrow strip along the south line. It also has about 150 acres in the east half of section 22.

The operations of this company are kept so secret that but little could be learned as to conditions over this area. Developments, however, seem in general to follow the rule which obtains farther to the west, that is, a gradual deepening of wells on the line of strike, or to the southeast, and an abrupt dip to the southwest.

All abandoned holes south of a line drawn from No. 43 to No. 52 may be safely assumed to be lost holes, due to mechanical troubles, of which this company has had its full share. Northeast of this line, which represents approximately the outcrop of the sands of the south dip, the case is different. A number of holes have been drilled northeast of this line, and while oil has been reported in some of them, none are now on the producing list, and it may be doubted whether, in any of these, discoveries have been made which could not be reasonably ascribed to small pockets in the broken material of the fault zone, deriving their oil from the sands of the south dip. In other words, the question as to whether any oil-bearing formations actually exist on the north limb of the fold does not seem to be settled by any developments on this section.

Mutual Oil Company. The well on the Bulla tract was drilled in 1898, by the Mutual Oil Company. This well was 1500 feet deep, and is said to have been abandoned because of crooked hole, without finding any oil.

Chandler Oil Mining Company. In the year 1901 this company drilled two wells near the outcrop of the south-dipping formation, to depths of 300 feet and 561 feet, respectively. The first well produced three barrels per day, for a time, of oil said to have been of 18° Beaumé, but was soon exhausted. The second got traces of the same oil, but not enough to pump, and both were abandoned.

Murphy Oil Company. The first well of this company was drilled in 1897, on the extreme northeast corner of section 27, to a depth of 527 feet. This well found traces only of oil, and was abandoned. Their second and third wells were drilled south of the Chandler wells, and were carried to 660 feet and 1760 feet, respectively, the first pumping a little oil for a short time, while the second was quite barren.

Since this time thirty-one wells have been started on the Whittier property, of which Nos. 2, 3 and 12 were originally producers, but have since been abandoned, 9A, 13A and 17A were lost in drilling, and Nos. 25, 26, 27 and 28 are still drilling. The balance are all on the producing list. It is said that No. 26 has reached a depth in excess of 4100 feet, without finding the light oil sand, but that a very prolific stratum of sand carrying heavy oil was cased off some distance up.

The data regarding these wells is so scanty that but little can be said

as to the structure of this part of the field. It is evident, however, that the producing strip is here much wider than it is farther northwest, and it seems highly probable that on this section the producing formation flattens considerably, so that the depths reached by the wells farthest southwest on this section are not so great as would be calculated from the dips on section 22. It is also probable that the producing formation plunges somewhat in a southeasterly direction, giving an increase of depth along the line of strike.

Union Oil Company of California. The Union Oil Company is now drilling two wells on the north half of section 25, 3–11, one in the extreme northwest corner, east of the old Chandler wells, the other just northwest of the center of the section. The progress of this work is not known.

Fullerton Oil Company. This company is now drilling two wells just south of the center line of section 25, and immediately south of the Union well above mentioned. One of these wells has baled some oil, which is in evidence on the sump.

Raymond Oil Company. A short distance southeast of the above, the Raymond Oil Company, of Pasadena, drilled a well in the year 1901. This well got some oil, but at a depth of 2269 feet the casing collapsed, and the hole was abandoned. There is some reason for thinking, in view of later developments to the south, that this well reached at least the top of the producing sands, and that with more fortunate mechanical conditions a profitable well might have been had.

Whittier Grande Oil Company. The well of this company was a short distance to the southeast of the Raymond well. This hole was abandoned at 900 feet because of lost tools.

Illinois Oil Company. The well of this company was just south of the north line of section 36, 3–11, and about one quarter east of the section corner. This hole was drilled in 1901 to a depth of 2300 feet, and abandoned for financial reasons. It is said to have found a little heavy oil, but if the structure of the country is at all normal the producing sands, if any, must lie much deeper than this.

Sentinel Oil Company. This hole was very shallow, exact depth not known, but said to have been 500 feet. Naturally, here no oil was found at this depth.

Standard Crude Oil Developing Company. This hole was drilled in 1901, and abandoned because of trouble with water. The depth was but 460 feet.

T. D. Holden. This well, on the southwest ten acres of section 24, 3–11, was drilled in 1899, to a depth of 1050 feet. Much salt water was struck, but no oil is reported.

E. F. Joyce. The two wells on the Joyce 30-acre tract, in the southwest forty of this section, were drilled in 1901 and 1902. Their depths were 1200 feet and 1450 feet, respectively, but the results obtained are not known.

Central Oil Company; section 24. The Central drilled one hole on this section, along the west line and north of the East Whittier wells, but nothing could be learned as to its depth or history.

East Whittier Oil Company. This company drilled two wells, in 1900 and 1901, along the west line of section 25, 3–11. No 1 was a dry hole at 1540 feet. Well No. 2 was carried down to 2200 feet, and abandoned when drilled.

Whittier Producers Oil Company. This company drilled two wells in the year 1901, near the center of the east line of section 24. These wells were 900 feet and 940 feet deep, and were abandoned because of water.

Whittier Oil & Development Company. The one well of this company was drilled in 1903, in the northwest quarter of the southeast quarter of section 24. Some oil was found at 1200 feet and at 1540 feet, and the well was considered an encouraging prospect, but at 2200 feet it was spoiled by the loss of a string of tools, and abandoned.

Fay-Granger Co. This company is drilling on the southeast quarter of section 24, 3–11, near the Whittier Oil & Development well.

Baldwin Ranch. A local company whose name can not be learned drilled a hole on the south line of Rancho Puente, just above the south line of section 13. This hole was carried to a depth of about 1000 feet, and abandoned for mechanical reasons. It is said to have found traces of light oil, but the report is somewhat vague.

Hart & Hayes. The Hayes well, in the southwest corner of the northwest forty of section 30, 2–10, was drilled in 1902. At a depth of 1700 feet this well was lost through casing trouble, without finding oil.

Golden Gate Oil Company. On the fractional piece south of the Hudson & Prudy tract, the Golden Gate Oil Company drilled a well in the year 1904. At a depth slightly in excess of 2000 feet they got into litigation over lease rights, and abandoned the hole.

The producing value of this well cannot now be determined, but it had some light oil. In 1910, the La Habra Oil Company put this well on the pump, and took out two hundred or more barrels of an oil reported to be of about 23° Beaumé. This would not necessarily represent any producing value for the hole as it stands, as the well had stood idle for about six years.

New England Oil Company. In the year 1900 to 1902 the New England Oil Company drilled three wells farther east on the same tract.

No. 1 was a lost hole at 400 feet, and No. 3 was stopped at about 1000 feet, owing to financial difficulties. No. 2 was carried to a depth of 2250 feet, reporting oil sands at 1500, 1800 and 1940 feet. When put on the pump, this well made a very good showing of light oil, and looked like a producer, but upper water gave some trouble, the casing was in bad shape, and after a long struggle the well was shut down.

La Habra Oil Company. In the year 1910 the New England property pasesd to the La Habra Oil Company, which pulled the inner strings from No. 2 well, and is deepening, apparently with some encouragement. The completion or failure of this test will give some indication of the probable value of this strip of territory, but will not throw any light on the prospects along the north dip, as these wells are located on a secondary fold, north of the main fold, but not a part of the formation which dips under the Chino Valley.

Union Oil Company; La Habra Lease. Near the New England wells, the Union Oil Company of California some years ago drilled La Habra No. 9. No data can be had regarding this well, which was abandoned.

In a cañon heading near these wells, and running down to La Habra valley, on section 32, 2–10, are six more wells drilled by this company. Some at least, and perhaps all, of these wells produced some heavy oil, but they were pumped for but a short time, and have since stood idle. In the latter part of 1910 work was again started on two of these wells, and was still under way in January, 1912. Nothing can be learned as to the depths, but as these holes were located directly over the seepage, it is probable that they were shallow. The surface formation here dips evenly and rather gently to the south, and the prospects indicated by the seepage would seem to be farther in that direction.

When last visited, in July, 1911, one of these wells had reached a depth reported at about 3100 feet, and looked like a good producer, of a light gassy oil apparently about 25° gravity.

The other two wells making up the nine on this tract were located in the northeast corner of section 33, 2–10. There are some indications of oil having been taken from these holes, but they are abandoned, and nothing is known as to their history.

RECAPITULATION.

The Whittier oil field, reading from the west end of the field to the west line of the Rancho Puente, and from the north line of developments to the south line of township 2–11, contains 244 wells, of which 134, or 55 per cent, are now producing; 94 wells, or 38 per cent, are abandoned, and 16 wells are drilling (April, 1912).

Of the abandoned wells, 32 were drilled to the depth desired and

found no oil whatever; 26 were drilled to depth and found a little oil, but not a profitable quantity; 12 were brought to production, and afterward lost through accident or mechanical defects, and 24 were lost in drilling, and abandoned at less than the desired depth.

The total production of the Whittier field proper (not including Coyote) in 1911 was approximately 807,000 barrels, or an average of 16.5 barrels per day per well. This production, however, was very unevenly distributed. The smallest well in the field, actually produced, gives an average of about one barrel per day, the largest perhaps 100 barrels steady production. The smallest average production for all the wells on any one lease is about 3.2 barrels per well per day, the average age of these wells being about ten years: another lease averages about 5 barrels per well per day, with an average age of five years for the wells. The largest average production for any one lease is approximately 44 barrels per well per day, with an average age for the wells of about five years. The average age of all the wells in the field is about nine years.

No very shallow wells are found at Whittier. The shallowest commercial producer in the field is down 1000 feet even. The deepest well now producing on section 22 is approximately 2400 feet deep, but a 3900-foot hole now drilling into deeper sands promises a good production. On section 25 a hole is now drilling at 4100 feet, but the average depth of the wells at this end of the field, while greater than that of the west-end wells, is much below this figure. The average depth of all the wells on section 22 is 1510 feet; the average for the entire field is close to 1650 feet.

Drilling conditions in Whittier were formerly considered onerous, owing to the steep pitch of the formation, and the presence of hard shells which made it very difficult to keep a straight hole. But it was soon learned that by using heavy pipe and following the hole closely, these shells could be entered without serious trouble, so that while drilling in this field requires much care, and is always slow, it is not considered difficult as compared with territory where running formations are encountered.

In spite of the constant repetition of the note "abandoned because of water" in the well records above, Whittier is not a wet field. Such water as is found is mainly in the older wells, and seems to be due mainly to the trouble experienced in carrying a tight water-string through the conglomerate, and in making a landing in the hard formation over the oil sands. These difficulties have disappeared with the use of heavier pipe and of cement, and the newer wells are in the main free from water. Such water as is being pumped with the oil is fresh upper water, and settles out readily, so that it causes little trouble. There is

no indication that water is anywhere in this field gaining on the oil sands, nor that bottom water has been entered.

Going back to the record of developments in the Whittier field proper, it may readily be seen from the results of work already done, that very little prospect exists for any material extension of the productive area, other than to the southwest and the southeast of section 26. For whatever may have been the results from Whittier Crude No. 13, the west fault curves in so close to present developments at this end as to leave but little room for extension, and the unbroken dip to Chino Valley begins but little north of the present limit of production.

What results may later be had from operations along this north dip can not be foretold. Along the extreme upper edge of this formation indications of oil do exist, and if we assume that only the upper edges are steeply pitched, and that the formation farther north is more gently inclined, it would be possible for productive sands to exist near the borders of Chino Valley. It is certain that these formations are productive under favorable conditions, for sands of the Puente group undoubtedly occur in these strata at a point where a gentle anticline is formed, but whether structural conditions are favorable anywhere north of the Whittier field is open to some doubt. The surface dips are consistent as far as the east line of the township, and while not nearly so steep farther north as they are at the south edge, where the strata are folded up sharply, they are yet steep enough to place the sands which outcrop at the south edge far out of reach at any point lower down the hill slope. And as there are not known to be any seepages or sand outcrops farther down (that is, higher up in the formation), it is probable that any productive sands which may exist at the west end of this north-dipping monocline are much too deep to be of any commercial value.

As to the secondary fold which crosses section 24, and in which the La Habra wells are situated: there is here the possibility of a narrow strip, parallel to the main field, but while individual locations may be profitable, the extreme complexity resulting from a very narrow and sharp fold argues against the value of the territory as a whole. Under such structural conditions operation is so expensive and uncertain that the successes must be very profitable indeed to cover the percentage of failures.

QUALITY OF WHITTIER OILS.

The oils of Whittier cover a wide range of gravity, the eighteen samples here recorded running from 14.2° to 24.0° Beaumé. Yet with one or two exceptions these oils, though varying greatly in percentage composition, are of the same general character and structure.

At the southwest corner of the field are a few wells producing a heavy oil, which gives very little light distillate, and contains more sulfur than

the lighter oils. This oil closely resembles the crudes of the City field at Los Angeles.

Farther north and east the oils are lighter, running from 18° to 20° Beaumé. These oils give no naphthas, and but a low asphalt yield, but are very low in sulfur, and give a lubricating stock of the best quality. The larger portion of this grade of crude is used for gas making, for which its low sulfur content particularly fits it.

The lightest oils are found at the north and east of the field, and run from 20° to 24° Beaumé. These oils as a rule give some gasoline and engine distillate, but the yield of light products is always very low for any given gravity. These oils also give a very clean and sweet lubricating stock, which works out to oils of good color, and such crudes are sought for refining, rather for their purity, than for any large yield of valuable products. In this respect they are sharply distinguished from the Salt Lake oils, which give high yields of light products, gravity considered, but in a very impure condition.

4405.*

Home Oil Company. Well No. 7.

Gravity ..... 14.2° Beaumé

This is a moderately limpid, brownish-black oil, with a rather strong odor, slightly sulfurous.

Distillation.

A sample of 150 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	8.2 per cent	41.2° Beaumé
Second cut	14.2 per cent	32.8°
Third cut	70.4 per cent	21.7°
Fixed carbon	7.2 grams per 100 c.c.	
	100.0 per cent	

The lubricating stock from this oil was not rerun. On calculating the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	8.0 per cent
Stove oil	33°	15.0 per cent
Middlings and lubricants	21.7°	59.0 per cent (not separated)
Asphalt	"D"	18.0 per cent, or 63.2 lbs. per bbl.
		100.0 per cent

The light products from this oil were a shade dark, but treated out very sweet. The lubricating stock appeared to be of good quality.

*Analysis by J. P. P.

7432.*

Whittier-Fillmore Oil Company. Well No. 1.

Gravity	14.8° Beaumé
Viscosity at 185° F.	4.42 Redwood
Sulfur	0.93 per cent by weight
Thermal value	18,115 British thermal units

Distillation.

Sample of 200 c.c., distilled from a glass flask, without steam or gas.

Below 482° F.	9.1 per cent	33.8° Beaumé
482 to 572°	19.5 per cent	26.1°
572° to grade—a	37.6 per cent	22.5°
572° to grade—b	3.8 per cent	23.5°
Asphalt	26.5 per cent	Grade "D" (about)
Water and loss	3.5 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	10.0 per cent
Middlings and lubricants	23.7°	60.0 per cent (not separated)
Asphalt	"D"	26.5 per cent, or 93.0 lbs. per bbl.
Water and loss		3.5 per cent
		100.0 per cent

4402.†

Turner Oil Company. Well No. 8.

Gravity	17.1° Beaumé

This is a moderately viscous, brownish-black oil, of mild odor.

Distillation.

Sample of 150 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to a residue of dry coke.

First cut	7.1 per cent	41.7° Beaumé
Second cut	7.1 per cent	32.1°
Third cut	78.3 per cent	21.3°
Fixed carbon	7.5 grams per	100 c.c.
	100.0 per cent	

The lubricating stock from this crude was not reduced. On calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	1.0 per cent (probably)
Kerosene	42°	6.0 per cent
Stove oil	33°	7.0 per cent
Middlings and lubricants	21.3°	67.2 per cent (not separated)
Asphalt	"D"	18.8 per cent, or 66.0 lbs. per bbl.
		100.0 per cent

The first 5 per cent of distillate from this crude had the gravity 47.6°,

*Analysis by H. N. Cooper.

†Analysis by J. P. P.

and it is probable that on a larger scale a small yield of 52° distillate could be had. Both the light products and the heavy stock appeared to be of good quality.

4404.*

Turner Oil Company. Well No. 4.

Gravity ---------- 17.5° Beaumé

This is a moderately limpid oil, of a brownish-black color, and mild, sweet odor.

Distillation.

Sample of 175 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	14.3 per cent	41.9° Beaumé
Second cut	13.1 per cent	30.7°
Third cut	61.6 per cent	25.0°
Fixed carbon	11.0 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	14.0 per cent
Stove oil	33°	11.0 per cent
Fuel distillate	29.7°	25.2 per cent / Slop distillate
Reduced stock	14.5°	22.3 per cent \ 25.0°—47.5%
Asphalt	"D"	27.5 per cent, or 96.5 lbs. per bbl.
		100.0 per cent

The light products ran a little dark from the crude still, but treated out readily and very clean. The lubricating stock gave a reduced oil of good color and medium viscosity, free from paraffin.

4403.*

Turner Oil Company. Well No. 7.

Gravity ---------- 18.3° Beaumé

This is a moderately limpid oil, of a brownish-black color and a mild, sweet odor.

Distillation.

A sample of 200 c.c., distilled from copper, first two cuts dry, last cut in a current of inert gas. Distillation to dry coke.

First cut	14.0 per cent	41.9° Beaumé
Second cut	14.0 per cent	33.0°
Third cut	65.1 per cent	20.5°
Fixed carbon	6.9 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt in the usual manner, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	14.0 per cent
Stove oil	33°	14.0 per cent
Fuel distillate	28.2°	21.9 per cent
Reduced stock	14.7°	32.8 per cent
Asphalt	"D"	17.3 per cent, or 60.7 lbs. per bbl.
		100.0 per cent

The light products ran pale from the still, and treated out readily to water-white, sweet oils. The lubricating stock was pale, sweet and of good viscosity. It gave a reduced stock of fair color and medium viscosity, free from paraffin.

4408.*

Fidelity Oil Company. Well No. 8.

Gravity ..... 19.6° Beaumé

This is a limpid, brownish-black oil, with a mild odor.

Distillation.

Sample of 170 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	15.7 per cent	42.0° Beaumé
Second cut	10.5 per cent	30.9°
Third cut	68.5 per cent	19.7°
Fixed carbon	5.3 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	15.7 per cent
Stove oil	33°	8.5 per cent
Fuel distillate	30.3°	20.6 per cent / Slop distillate
Reduced stock	16.4°	41.9 per cent \ 19.7°—62.5%
Asphalt	"D"	13.3 per cent, or 46.7 lbs. per bbl.
		100.0 per cent

The light products from this oil ran dark, but treated out to fair colors and good odor. The lubricating stock was rather bluish, with low viscosity, but gave a reduced stock of good color and fair viscosity, with traces of amorphous paraffin.

*Analysis by J. P. P.

4496.*

Home Oil Company. Well No. 8.

Gravity ---------- 19.7° Beaumé

This is a moderately limpid oil of brownish-black color and sweet odor.

Distillation.

Sample of 500 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation carried to a residue of dry coke.

First cut	9.8 per cent	42.8° Beaumé
Second cut	16.1 per cent	32.2°
Third cut	68.5 per cent	21.5°
Fixed carbon	5.6 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	10.5 per cent
Stove oil	33°	14.0 per cent
Fuel distillate	30.0°	24.6 per cent } Slop distillate
Reduced stock	15.3°	36.9 per cent } 21.5°—61.5%
Asphalt	"D"	14.0 per cent, or 49.1 lbs. per bbl.
		100.0 per cent

The light products from this oil ran dark, but treated out to very sweet oils of fair color. The heavy distillate was rather dark and bluish, but gave a reduced stock of good color and viscosity. This treated out to a 17.1° engine oil of rather low viscosity, but having a fine red color and green over tone, and free from paraffin.

4410.*

Warner Oil Company. Well No. 9.

Gravity ---------- 20.5° Beaumé

This is a limpid, brownish-black oil, with a mild odor.

Distillation.

Sample of 125 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	18.2 per cent	41.0° Beaumé
Second cut	7.8 per cent	31.1°
Third cut	66.7 per cent	19.5°
Fixed carbon	7.3 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	16.0 per cent
Stove oil	33°	10.0 per cent
Fuel distillate	30.0°	17.8 per cent / Slop distillate
Reduced stock	15.3°	37.9 per cent \ 19.5°—55.7%
Asphalt	"D"	18.3 per cent, or 64.2 lbs. per bbl.
		100.0 per cent

The kerosene from this stock was of average color, and took the acid well. The heavy distillate gave a reduced stock of good color and high viscosity, but showing a little paraffin.

7435.*

Home Oil Company. Well No. 15.

Gravity ..... 20.7° Beaumé

Distillation.

Sample of 200 c.c., distilled from a glass flask, without steam or gas.

Below 302° F.	4.2 per cent	50.5° Beaumé
302 to 392°	9.6 per cent	38.4°
392 to 482°	14.0 per cent	31.4°
482 to 572°	14.7 per cent	26.1°
572° to grade—a	23.0 per cent	22.0°
572° to grade—b	16.8 per cent	22.7°
Asphalt	15.7 per cent	Grade "D" (about)
Loss	2.0 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	3.0 per cent
Kerosene	42°	6.0 per cent
Stove oil	33°	18.0 per cent
Middlings and lubricants	22.9°	55.3 per cent
Asphalt	"D"	15.7 per cent
Loss		2.0 per cent
		100.0 per cent

2451.†

Murphy Oil Company. Well No. 4.

Gravity ..... 21.0° Beaumé

This is a moderately limpid oil, with a greenish-black color, and a mild, sweet odor.

Distillation.

A sample of 200 c.c., distilled from glass to a temperature of 518° F. Residue from this distillation reduced to "D" asphalt in vacuum. Lubricating stock

*Analysis by H. N. Cooper.

†Analysis by Wayne Colver.

from this run reduced to an 18.6° stock in vacuum. The results from the three distillations are:

Crude oil:		
Below 302° F.	2.2 per cent	53.0° Beaumé
302 to 518°	23.9 per cent	38.2°
Residue above 518°	73.9 per cent	13.9°
	100.0 per cent	
Residue from above:		
Lubricating stock	51.2 per cent	22.6° Beaumé
Asphalt	22.7 per cent	Grade "D"
	73.9	
Lubricating stock from above:		
Fuel distillate	15.4 per cent	31.8° Beaumé
Reduced stock	35.8 per cent	18.6°
	51.2	

On bringing these figures together, they give the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	3.0 per cent
Kerosene	42°	15.0 per cent
Stove oil	33°	8.1 per cent
Fuel distillate	31.8°	15.4 per cent
Reduced stock	18.6°	35.8 per cent
Asphalt	"D"	22.7 per cent, or 79.7 lbs. per bbl.
		100.0 per cent

4401.*

Murphy Oil Company. Well No. 25.

Gravity 21.2° Beaumé

This is a moderately limpid oil, of a greenish-black color, and a mild odor.

Distillation.

A sample of 150 c.c., distilled from copper, first two cuts dry, last cut in a current of inert gas. Distillation to dry coke.

First cut	16.1 per cent	39.9° Beaumé
Second cut	10.0 per cent	32.2°
Third cut	64.4 per cent	23.6°
Fixed carbon	9.5 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is obtained:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	12.0 per cent (about)
Stove oil	33°	16.0 per cent
Fuel distillate	28.9°	15.4 per cent / Slop distillate
Reduced stock	18.2°	32.8 per cent \ 23.6°—48.2%
Asphalt	"D"	23.8 per cent, or 83.5 lbs. per bbl.
		100.0 per cent

*Analysis by J. P. P.

The light products from this oil run dark from the still, but treat out in a satisfactory manner. The lubricating stock is sweet, rather low in viscosity, but not burned, and of fair color. This gives a reduced stock of rather low viscosity, but of fine color, and free from paraffin.

The entire lack of naphthas from this oil is rather surprising, as the sample was undoubtedly fresh. The heavy end of the oil is of first quality.

4493.*

Whittier Crude Oil Company. Well No. 1.

Gravity ..... 21.4° Beaumé

This is a limpid oil of a brownish-black color and mild odor.

Distillation.

Sample of 150 c.c. was distilled from copper, first three cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	5.6 per cent	49.8° Beaumé
Second cut	10.1 per cent	41.3°
Third cut	11.8 per cent	31.6°
Fourth cut	67.9 per cent	20.2°
Fixed carbon	4.6 grams per 100 c.c.	

100.0 per cent

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	2.5 per cent
Kerosene	42°	13.0 per cent
Stove oil	33°	10.0 per cent
Fuel distillate	28.8°	17.6 per cent / Slop distillate
Reduced stock	15.3°	45.4 per cent \ 20.2°—63.0%
Asphalt	"D"	11.5 per cent, or 40.4 lbs. per bbl.

100.0 per cent

The light products from this oil ran rather dark, but cleared up readily with the acid, to very sweet oils. The lubricating stock was very mild and sweet, of fair color and medium viscosity. It gave a low viscosity reduced stock, which treated out to a medium red-engine oil of 17.5° Beaumé, of rather low viscosity, and free from paraffin.

4411.*

Murphy Oil Company. Well No. 23.

Gravity ..... 22.6° Beaumé

This is a limpid, brownish-black oil, showing a slight green tinge, and having a mild, sweet odor.

Distillation.

A sample of 230 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	5.3 per cent	49.4° Beaumé
Second cut	7.1 per cent	42.3°
Third cut	24.2 per cent	32.7°
Fourth cut	58.7 per cent	20.9°
Fixed carbon	4.7 grams per 100 c.c.	

100.0 per cent

*Analysis by J. P. P.

On reduction of the lubricating stock in a stream of gas, and calculation of the coke to asphalt, the commercial analysis is as follows:

Gasoline	61° Beaumé	None
Engine distillate	52°	3.0 per cent
Kerosene	42°	11.0 per cent
Stove oil	33°	22.0 per cent
Fuel distillate	27.3°	23.0 per cent / Slop distillate
Reduced stock	16.2°	29.2 per cent \ 20.9°—52.2%
Asphalt	"D"	11.8 per cent, or 41.4 lbs. per bbl.
		100.0 per cent

The light products from this oil ran very pale and sweet, and took the acid well. The character of the lubricating stock was not noted.

2448.*

Murphy Oil Company. Well No. 2.

Gravity ..... 23.1° Beaumé

This is a moderately limpid, greenish-black oil, with a mild, sweet odor.

Distillation.

Sample of 100 c.c., distilled from glass to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor x 0.8) for oxidation during evaporation. The original figures are as follows:

Below 302° F.	5.2 per cent	55.0° Beaumé
302 to 518°	27.3 per cent	38.4°
Residue above 518°	65.0 per cent	15.0°
Loss	2.5 per cent	
	100.0 per cent	

After evaporation of the residue to asphalt, and calculation, the above figures are approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	10.0 per cent
Kerosene	42°	12.5 per cent
Stove oil and lubricants	---	58.9 per cent (not separated)
Asphalt	"D"	18.6 per cent, or 65.3 lbs. per bbl.
		100.0 per cent

4495.†

Whittier Crude Oil Company. Well No. 12.

Gravity ..... 23.1° Beaumé

This is a limpid oil of exactly the same appearance as No. 4494.

Distillation.

Sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distilled to dry coke.

First cut	7.6 per cent	60.6° Beaumé
Second cut	6.3 per cent	50.2°
Third cut	7.2 per cent	41.7°
Fourth cut	13.5 per cent	32.6°
Fifth cut	59.8 per cent	20.0°
Fixed carbon	5.6 grams per 100 c.c.	
	100.0 per cent	

*Analysis by Wayne Colver.
†Analysis by J. P. P.

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	7.5 per cent	
Engine distillate	52°	5.0 per cent	
Kerosene	42°	8.5 per cent	
Stove oil	33°	13.5 per cent	
Fuel distillate	28.4°	19.0 per cent	Slop distillate
Reduced stock	14.8°	32.5 per cent	20.0°—51.5%
Asphalt	"D"	14.0 per cent, or 49.1 lbs. per bbl.	
		100.0 per cent	

The light products from this crude ran yellow, but treated out fairly well with the test acid. The lubricating stock had a very rich green tone, fair color, low viscosity and mild odor. On reduction this gave a medium viscosity reduced stock, with some crystallization. The red oil prepared from this stock had a good red color and a fine green outer tone, with a viscosity normal to the gravity, 15.0° Beaumé.

This crude does not handle quite so well as No. 4494, and shows more paraffin, which is of the amorphous consistency, thus reducing the value of the heavy end of the oil.

2470.*

Murphy Oil Company. Well No. 3.

Gravity ..... 23.2° Beaumé

This is a limpid oil, of a greenish black color, and a sweet, gassy odor.

Distillation.

A sample of 200 c.c., distilled from glass to a temperature of 518° F. Residue from this distillation reduced to "D" asphalt in vacuum. Lubricating stock from this run reduced to a 19.5° stock in vacuum. The results from these three distillations are:

Crude oil:		
Below 302° F.	4.9 per cent	57.0° Beaumé
302 to 518°	29.4 per cent	39.3°
Residue above 518°	65.7 per cent	13.2°
	100.0 per cent	
Residue from above:		
Lubricating stock	42.0 per cent	24.5° Beaumé
Asphalt	23.7 per cent	Soft "D"
	65.7 per cent	
Lubricating stock from above:		
Fuel distillate	11.0 per cent	33.2° Beaumé
Reduced stock	31.0 per cent	19.5°
	42.0 per cent	

*Analysis by Wayne Colver.

On bringing these figures together, they give the following commercial analysis:

Gasoline	61° Beaumé	2.0 per cent (about)
Engine distillate	52°	4.0 per cent (about)
Kerosene	42°	18.0 per cent (about)
Stove oil	33°	10.3 per cent
Fuel distillate	33.2°	11.0 per cent
Reduced stock	19.5°	31.0 per cent
Asphalt	---	23.7 per cent, or 69.1 lbs. per bbl.
		100.0 per cent

4492.*

Whittier Crude Oil Company. Well No. 5.

Gravity ---------- 23.4° Beaumé

This is a limpid oil of a brownish-black color, with a slight greenish tinge, and a mild, sweet odor.

Distillation.

Sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	5.1 per cent	60.6° Beaumé
Second cut	5.1 per cent	49.3°
Third cut	5.5 per cent	41.8°
Fourth cut	22.6 per cent	32.6°
Fifth cut	56.8 per cent	21.5°
Fixed carbon	4.9 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of inert gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	5.0 per cent
Engine distillate	52°	3.0 per cent
Kerosene	42°	10.0 per cent
Stove oil	33°	19.0 per cent
Fuel distillate	30.4°	20.3 per cent / Slop distillate
Reduced stock	15.4°	30.4 per cent \ 21.5°—50.7%
Asphalt	"D"	12.3 per cent, or 43.2 lbs. per bbl.
		100.0 per cent

The light products from this oil ran rather dark, and treated out only fairly well. The lubricating stock was of good color, sweet and of medium viscosity. The reduced stock was of high viscosity and rather dark—it treated out to a 17.1° red oil of good color, free from paraffin.

*Analysis by J. P. P.

4494.*

Whittier Crude Oil Company. Well No. 8.

Gravity ..... 24.0° Beaumé

This is a limpid, brownish-black oil, of a very mild and sweet odor.

Distillation.

Sample of 150 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	6.2 per cent	59.7° Beaumé
Second cut	5.5 per cent	51.6°
Third cut	11.1 per cent	41.8°
Fourth cut	5.5 per cent	33.0°
Fifth cut	65.8 per cent	20.2°
Fixed carbon	5.9 grams per 100 c.c.	

100.0 per cent

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	4.5 per cent
Engine distillate	52°	7.0 per cent
Kerosene	42°	11.5 per cent
Stove oil	33°	5.5 per cent
Fuel distillate	29.4°	17.6 per cent / Slop distillate
Reduced stock	16.1°	39.1 per cent \ 20.2°—56.7%
Asphalt	"D"	14.8 per cent, or 51.9 lbs. per bbl.

100.0 per cent

The light products from this oil ran a shade dark, but treated out readily to white, sweet oils. The lubricating stock had normal color and viscosity, reduced to a stock of low viscosity and rather dark color, and treated out to a red engine-oil of 18.0° Beaumé, of a rich red color and fine green tone. This crude works very well at both ends, and for the percentages given is a very satisfactory refining oil.

*Analysis by J. P. P.

CHAPTER XIV.

COYOTE AND ANAHEIM.

The producing strip of the Whittier field would, if continued in a straight line, cross section 6, 3–10. But there is sufficient evidence to show that at about the eastern limit of present developments, this formation trends farther to the north, taking an approximate east and west line. Whether this formation will ever be productive farther to the east than at present is problematical, but it is quite certain that the developments in the Coyote hills are not in any sense an extension of the Whittier field proper.

There can be little doubt that the wells of the Coyote hills are located on a true anticline, having a strike approximately parallel to the main fault back of the Whittier field. The Murphy wells on section 18 would appear to be on the apex of this fold, with the San Juan, Whittier–Des Moines and Bastanchury wells on the north dip. The south limb, if such an anticline indeed exists, is yet untested.

The Coyotes disappear a short distance east of the Murphy wells, and as the surface of the valley in this direction gives little or no hint of the structure beneath, it is impossible to determine how far this fold extends to the east from the Murphy wells. On the one hand, the rapid deepening between Murphy No. 3 and Bastanchury No. 1 would indicate that, if it does extend in this direction, it plunges so sharply as to be within reach of the drill but a short distance. On the other hand, the failure of the deep well of the Syndicate, south of Brea Cañon, followed by a discovery at a much less depth in the Amalgamated's Anaheim wells, indicates that such a fold exists here also, whether or not it connects with the Coyote anticline. The Amalgamated wells, it will be observed, are exactly in the line of strike of the Coyote fold. Considerable drilling is now under way across the intervening distance, and this point will soon be determined. At present, the bounds of these two fields, or one field, as the case may be, can not be even guessed.

In the Coyote group, five wells are producing, four have been abandoned, and six were being drilled in January, 1912. In the Anaheim group, at the same date, three wells were producing and nine drilling. A number of new outfits have started up since this date.

Coyote Hills Oil Company. The well of this company is on the southeast quarter, northwest quarter, section 14, 3–11. It was started in 1910, and has never reached any great depth, having had mechanical trouble from the start.

Standard Oil Company—Leffingwell. This hole is on the southwest quarter of section 11, 3–11. When last reported it was drilling at 3360

feet, and had not made any discovery to this time. This hole is some distance north of the apparent strike of the fold on which the Murphy wells are located.

Standard Oil Company—Toler. The Standard well on the J. Toler place is in the northeast quarter of section 12, 3–11, and just south of the La Habra line of the Pacific Electric. When last reported, this well was drilling at about 3500 feet.

Murphy Oil Company—Coyote. The five wells are all on the south half of section 18, 3–10, and apparently on the north limb of the Coyote fold, though No. 5, the well farthest to the south, may be slightly south of the apex.

Well No. 1 was finished in the year 1908, at a depth of 3300 feet, and was a producer. Being a prospect hole in difficult territory, this well was in bad condition when finished, and has always given some trouble. The fact that it has never produced much oil seems to be due entirely to mechanical reasons.

Numbers 2 and 3 were finished in 1909, at depths of 3325 feet and 3500 feet, respectively, and have been very heavy producers of a volatile oil of about 30° gravity, that from No. 3 being somewhat the lighter. Certain peculiarities of this oil are indicated in the analyses below.

Well No. 4 was finished in the year 1910, at a depth of 3400 feet, and was a producer. This well originally had much water trouble, but a cementing job, finished in the last months of the year, corrected this somewhat, though this well has never been the equal in production of either No. 2 or No. 3.

Well No. 5 was finished in 1912, and is also a large producer. Its depth is not known, but it is said to be somewhat deeper than any of the preceding wells. No. 6 was rigging in January, 1912, on the summit of the hill, due west of No. 5.

These have been among the most profitable wells ever drilled in California, though in their earlier history they gave a great deal of trouble. For some reasons not clear, but probably because of the lack of a firm landing for water-string, at least the four earlier wells were at first very wet, and produced an emulsified oil. It is not known just what means were taken to correct this difficulty, though it was done by cementing in some form, and all are now free from water trouble, and make a dry oil. The gas pressure in this formation is very high. Well No. 2 when first drilled was almost a wild well, being controlled with some difficulty. It is said to have flowed several thousand barrels per day, but soon sanded, and repeated this whenever opened up. The well is now controlled by a steel cap, out of which is taken a 3/8-inch tube some fifty feet long, connecting with the lead line—the similar vent from well No. 4 is but 1/4-inch inside diameter. Through these small vents the oil and gas

pass with such force that even at the vent of the 2-inch lead-line the velocity is still very high, and much spray is thrown into the receiving tanks. The pressure on well No. 2, at the casing head while flowing through the vent, is even at about 450 pounds per square inch, and the yield of this well is said to be very steady at between three hundred and four hundred barrels per day. No trouble with sanding is experienced so long as the flow is thus restrained. The average actual output of the four wells in operation during the year 1911 is said to have been close to 250 barrels per well per day.

International Oil Company. This well, located a short distance down the cañon (north) from Murphy No. 2, was drilled about the year 1900. The depth of this well is said to have been 560 feet. It found no oil, but had enough gas at one point to lift the tools from the hole.

Whittier-Des Moines Oil Company. This company drilled a well on the southwest quarter of the southeast quarter of section 7, 3–10. It was carried to a depth slightly over 3500 feet, finding no pay oil to this depth, though there were colors of a rather heavy oil toward the bottom of the hole. If the anticlinal structure indicated on the surface at the Murphy wells is conformable to the structure beneath, this well probably had some distance to go before finding the Coyote sands. When last visited the well was suspended, and apparently had not been worked on for some time.

Shafer Oil Company. The well drilled by this company is on the southeast quarter of the southwest quarter of section 8, 3–10. It was abandoned in 1911, at a depth of some 1500 feet, as a spoiled hole. This well had a great deal of casing trouble.

Union Oil Company of California—San Juan. The San Juan well of the Union Oil Company is on the southwest quarter of the southwest quarter of section 9, 3–10. This well has been drilling for about three years, and at last reports had reached a depth of 4608 feet (January, 1912). It was thought to have passed through an oil sand, but there was so much water that this could not be told with certainty, and preparations were then being made to cement.

Union Oil Company of California—Bastanchury. The Bastanchury wells of the Union Oil Company are along the west line of section 16, 3–10, due east of the Murphy wells.

Well No. 1 was finished in 1909 at a depth of 4444 feet, and was an excellent producer, flowing several hundred barrels per day of an oil of about 20° Beaumé. To reach this depth the casing had been reduced to 2½ inch, and when a string of tools was lost in cleaning, they could never be recovered. The well was thus choked down to about twenty barrels per day, which it is still doing on the pump. Well No. 2 was located a short distance to the north, and was a shallow, spoiled hole.

Well No. 3 is perhaps one half mile east of No. 1, and in the line of strike from this and from the Murphy wells. It is now drilling at about 4000 feet, and is reported to have passed through a nonproductive sand, giving a small amount of oil.

It would appear from the surface indications that well No. 1 is somewhat down the dip from the Murphy wells, the strike of the fold being apparently somewhat south of east. This view would be borne out by the much greater depth of this well, but in this connection the change in gravity from 30° to 20° in this distance is hard to explain. It is possible that the fold plunges in this direction, though this would not explain the decrease in gravity of the oil, and there is also the possibility of a fault intervening between the two groups of wells. As the surface of the country is almost completely covered, and but slight evidences of the structure visible, considerable drilling will be required before the actual structure of this territory is known with any degree of certainty.

Fisher Oil Company. This company is drilling on the southwest quarter of section 14, 3–10. In March, 1912, this well was reported as drilling at about 2000 feet.

Standard Oil Company—Yriarte. On the Yriarte tract the Standard Oil Company is drilling one well, on the southeast quarter of section 14, 3–10. In March, 1912, this well was reported to be approximately 3500 deep, or deeper than the earlier wells on the Anaheim lease just east of it. At this depth the water had not been shut off, and the possible productiveness of the well was not yet known.

Amalgamated Oil Company—Anaheim. On the Anaheim Water Company lease, on the west half of southeast quarter of section 13, 3–10, the Amalgamated Oil Company has five producing wells, and several drilling. Well No. 1 was finished in the year 1911, having been drilled very rapidly with a heavy rotary outfit. In January of this year it was on the beam, and making, it is said, up to 500 barrels per day of an oil of about 16° Beaumé. Well No. 2 is also a producer. No. 3 is a test well, and in March, 1912, was down 3975 feet and drilling, having passed through the sands found in the other wells. Well No. 4 is a producer at about 3100 feet, but No. 5 is said to have carried upper water into the sands, and to have but a small output. The numbers up to 12 have been rigged, and drilling is actively under way on this lease.

Aside from No. 3, the depths of the wells on this lease run from 3300 feet to 3500 feet, and it is said that the formation lies rather flat. The illustration in the margin shows the log of one of these wells.

Union Oil Company—Graham Loftus. On the north half, and the east half of the southeast quarter of section 13, 3–10, a lease from the Graham-Loftus Oil Company, the Union Oil Company is drilling several wells, close to the Anaheim line. None of these wells have reached a depth to give much information.

6468.*

Amalgamated Oil Company. Anaheim Well No. 1.

Gravity ..... 16.4° Beaumé

This is a moderately thick oil of a brownish-black color, with a mild and sweet odor.

Distillation.

A sample of 200 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	2.5 per cent	52.0° Beaumé
Second cut	7.4 per cent	41.4°
Third cut	13.1 per cent	32.8°
Fourth cut	65.8 per cent	22.5°
Fixed carbon	11.2 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the fixed carbon to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	2.5 per cent
Kerosene	42°	13.6 per cent
Stove oil	33°	13.5 per cent
Fuel distillate	30.6°	24.5 per cent) Slop distillate
Reduced stock	16.7°	24.5 per cent) 22.5°—49.0%
Asphalt	"D"	28.0 per cent, or 98.3 lbs. per bbl.
		100.0 per cent

The kerosene stock from this crude ran rather dark, but with the test acid treated out to a fair white color, and a very mild odor. The stove oil contained sulfur, and had a foul odor, which did not yield to treatment, but did not appear to be decomposed.

The lubricating stock had a good color and medium viscosity, and the reduced stock had the same qualities, but both showed a little paraffin, which commenced to separate above 75° F.

4407.

Union Oil Company. Coyote. Bastanchury No. 1.

Gravity ..... 21.0° Beaumé

This is a moderately limpid oil, of a brownish-black color and mild odor.

Distillation.

Sample of 100 c.c., distilled from copper, in a current of gas. The figures for the light products were spoiled, and the sample could not be duplicated. Distillation started in the lower 40s, and the oil gave a small yield of kerosene. The decomposition noted with the Murphy samples did not take place on this oil.

The latter part of the lubricating stock solidified as it came from the still, and contains a great deal of paraffin. The oil yielded 19.0 per cent of "D" asphalt.

*Analysis by J. P. P.

4406.*

Murphy Oil Company. Coyote. Wells 2 and 3, a mixture.

Gravity, Well No. 2 ..... 30.7° Beaumé
Gravity, Well No. 3 ..... 29.2° Beaumé

Both these samples were very limpid oils, with a brownish color and mild, gassy odor. The sample from No. 3 contained a little emulsified water.

Distillation.

Sample of 200 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	9.3 per cent	60.8° Beaumé
Second cut	6.0 per cent	50.2°
Third cut	16.7 per cent	41.9°
Fourth cut	41.1 per cent	33.0°
Fifth cut	16.4 per cent	23.0°
Fixed carbon	10.5 grams per	100 c.c.
	100.0 per cent	

The quantity of lubricating stock was too small to reduce. On calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	9.0 per cent
Engine distillate	52°	5.0 per cent
Kerosene	42°	17.0 per cent
Stove oil	33°	41.0 per cent
Middlings and lubricants	23.0°	1.8 per cent
Asphalt	"D"	26.2 per cent, or 92.0 lbs. per bbl.
		100.0 per cent

This oil behaved in a very peculiar manner on distillation. The first two cuts came off white and sweet, and were of the best quality. Decomposition commenced at about the middle of the kerosene cut, and became very noticeable while the stove oil was running, and though all the conditions were the same as were observed with a great many other samples in this series (4400 and 5400 numbers), the gravity hung at 33° for so long that practically all the lubricating stock was broken down to this gravity. The last end of the stove oil, and the small amount of lubricating stock taken off, showed crystalline paraffin, and were badly burned. It would be almost impossible to produce this amount of decomposition with any ordinary California oil.

The yield of asphalt stated is no doubt too large, the percentage of coke being increased by the breaking down of the heavy stock. This end of the oil seems to be too tender to be of much value. The light products, including kerosene, could be taken off without much, if any, burning when working on a larger scale.

*Analysis by P. W. P.

CHAPTER XV.

PUENTE WELLS.

The wells of the Puente group are situated on the Rowland and Grazide tracts of the Puente Rancho, on the east half of section 34, and the west half of section 35, in township 2 south, range 10 west, S. B. M. All the producing wells are located in a compact group, though scattered over the surrounding territory are nine unsuccessful prospect wells, which will be mentioned in connection with the Puente wells proper.

This is one of the earliest locations on which successful oil development was carried out, well No. 1 of Rowland & Lacy, the predecessors of the Puente Oil Company, having been drilled about the year 1880. It is but natural that in the intervening years much attention should have been paid to the geology of this territory, yet it must be admitted that many details as to the structure of this formation are open to doubt. It will be sufficient to state here that the producing formations in this group are of firm and consistent sandstones underlying shales of varying hardness, the general structure being that of a modified anticline, with its axis lying roughly east and west, and probably considerably cross-folded or faulted.

The axis of this anticline is found near the north and south center of the group of wells, and appears to take a course slightly south of east, plunging a little in this direction. To the east, the sands are found in place, and carry some oil, but have not been commercially productive. To the west several wells have been drilled which have found the shallower sands too dry for profitable operation, but it does not appear that any of these wells went deep enough to reach the lower sands, which have been discovered in later wells.

On the south the deep Scott well, which was entirely barren, sets a definite limit to operations, and the gradual diminution in productiveness of the sands as wells are drilled in this direction indicates that the limit of profitable operation has already been nearly reached. The results from the wells to the north, on the contrary, do not show any decrease in oil-carrying capacity, and as the dip is gentle, and the deepest wells so far drilled are shallow, there can be no present limit set to developments in this direction.

Well Records.

The first well of Rowland & Lacy was drilled about the year 1880, to a depth of 150 feet. Well No. 2, drilled in 1882, had the same depth, and well No. 3, of about the same age, was 260 feet deep. These wells have long ceased to produce, but an old report states that they made some forty or fifty barrels per month (in the year 1887) of a "rather

thick maltha of about 20° Beaumé.'' These wells were just south of the bed of a cañon following the axis of the anticline. North of the bed of this cañon was a line of small croppings of brea, which have since disappeared. It is to be supposed that these first wells penetrated only an upper ''tar sand,'' possibly only a seepage deposit due to a little local fault along the antielinal axis.

Well No. 4 was drilled in 1886, and was 970 feet deep. Well No. 5, drilled in the same year, was 1220 feet deep, and No. 6, finished in 1887, was 750 feet deep. These wells were east and north of the discovery wells, and therefore near the west center of the group. During the first year of their existence these wells averaged about 100 barrels per day for the three, No. 4 being the most productive. The gravity of this oil approximated 32° Beaumé. These wells, together with well No. 7, which was drilled in 1888 to a depth of 867 feet, are still on the pump, though No. 8, drilled in 1887 to a depth of 925 feet, was exhausted and abandoned after twenty years of service. It will be noted that No. 7 is the farthest producer to the west, while No. 8 is surrounded by producing wells. Considerable local variations of this sort are noted throughout this territory, an explanation lying in the fact that oil is found, not in extended sand beds, but in small lenses, varying in thickness and productive value, and often of so slight an extent as to be found in but a single well.

Well No. 9, drilled in 1889 to a depth of 960 feet, is still in service. No. 10 appears to have been too far to the west to find production in the upper sand, which was the only one known at the time this hole was put down. It was abandoned at 955 feet, with 1½ barrels heavy oil at 540 feet, but nothing below. Nos. 11 and 13 were producers at 1055 and 1075 feet, respectively, and were exhausted after pumping for thirteen and sixteen years. Nos. 12 and 14 were drilled in 1889 to depths of 1060 and 1140 feet, and are still producing. These wells are on the north line of developments. Well No. 15, toward the west center of the group, and No. 16, toward the northwest corner, were drilled in 1891, and are still on the production list. Well No. 17, which was far to the northwest of any of the other wells, was drilled in the same year to a depth of 1450 feet, and was apparently a dry hole.

Well No. 18 was not finished until 1898, and was abandoned at a depth of 1440 feet. It is surrounded by producers of less depth, and is probably a spoiled hole, though the reason for abandoning is not known with certainty.

Well No. 19 is just west of No. 3, one of the original shallow holes, and is probably very close to the apex of the anticline. It was drilled in 1892, and is still a producer at a depth of 710 feet. This well is a remarkable illustration of the permanence of shallow holes in moderately hard formation.

Nos. 20, 21, 22 and 23 were drilled between 1892 and 1895, and are still on the pump. The depths of these wells is 900 feet, 1200 feet, 1090 feet and 1213 feet, respectively. These wells are all on the south limb of the anticline, but not very far down the dip. Well No. 24, drilled in 1893, is near the center of the group in an east and west direction, but is at the south limit of developments. This hole was abandoned at a depth of 1455 feet, when drilled, and is said to have shown but very little oil. This depth, of course, is not enough to reach the lower sands, if they exist on this limb. Well No. 25, which is in about the same position on the formation, but farther west, was put on the pump at 1265 feet, but after producing a small quantity for five and one half years, was abandoned as exhausted. This well made 8 barrels daily when drilled, but in two years had dropped to 3 barrels daily.

Wells having numbers from 26 to 35 were drilled between 1893 and 1896, and are still producers. The depth of these holes ranges from 1175 feet to 1540 feet. They are all near the apex, or a short distance down the south dip.

Wells No. 36 and No. 40 were in a straight line with the apex of the anticline—that is, they would be located on the apex if the formation extended in a straight line this far to the east. They were about one and one half miles east of the center of the group, and on the Rancho Rincon. These wells were drilled in 1897, to 1375 feet and 1605 feet, respectively, and while they showed traces of oil, were abandoned as unprofitable. It is said that these wells passed through several thin sands similar in character to those met farther west, but containing very little oil.

Well No. 38 is almost due south of No. 10, and at the western limit of development, in the line of strike with the Discovery wells. This was a dry hole at 1275 feet.

Wells No. 37, 1200 feet deep, No. 39, 1175 feet, No. 41, 1455 feet, No. 42, 1290 feet, and No. 43, 1450 feet, were all drilled in this same year, and are still on the pump. Well No. 44 is to the northeast of other wells of this group. It was drilled in 1898, is 1610 feet deep, and was abandoned as exhausted after producing for ten years. Well No. 46, which is due west of No. 44, but somewhat closer to the apex of the anticline, was drilled in the same year, and was abandoned after pumping for two months. This was probably due to mechanical defects, as No. 51, drilled immediately adjacent to this hole, and but slightly deeper (1215 feet) is still producing. Well No. 47, one location southeast of No. 44, was abandoned at 1030 feet, and never produced—it was probably a spoiled hole.

Wells numbered from 48 to 55 were drilled during the years 1898 and 1899, and are still pumping. The depths of these holes ranges from

1215 feet to 1685 feet, which is from two to three hundred feet greater than the depths of adjacent holes drilled a few years earlier.

Wells having numbers from 56 to 61 were drilled in the years 1900 to 1902 and are still producing. The depths of these wells ranges from 1172 feet to 1796 feet. Well No. 62 is some distance to the southeast, and the farthest south of any well in the group. It was drilled in 1901, is 1505 feet deep, and is apparently a dry hole.

Well No. 64 is a prospect hole, a short distance southeast of No. 38, and though carried much deeper, was entirely barren. This well was drilled in 1902, and is 1614 feet deep. Numbers 63, 65, 66 and 67 were drilled in 1902 and 1903, and are still producing. These wells are respectively 1064 feet, 1927 feet, 1412 feet and 1450 feet deep.

Well No. 68, located between Nos. 24 and 25, but farther north, pumped one year and was then abandoned as exhausted. This well went to a depth of 1655 feet, or 440 feet deeper than No. 25. No. 69, however, which is in a corresponding position to the west of No. 25, was carried to a depth of 1305 feet, and was a dry hole. This well is farther up on the formation than No. 25, and 80 feet deeper, yet the latter pumped for five years. No. 70 was the last well drilled in 1903, and is a producer at 1600 feet.

No further development work was done until the year 1910, when wells No. 71 and 72 were drilled, to depths of 2340 feet and 2226 feet, respectively. It will be noted that these wells are nearly 1000 feet deeper than adjacent wells previously drilled, and it is reported that they have tapped lower and more prolific sands, whose existence was not previously suspected. Prospecting has not yet been advanced sufficiently to determine the area of these lower sands. The oil produced by well No. 71 has the gravity 26.3°, which is about 1½° heavier than the present average from the lease.

On the Rowland tract, the Puente Oil Company drilled eleven wells, numbered Rowland No. 1 to Rowland No. 11. These wells lie to the east of those above described. But two of these wells are productive, No. 4, which lies close to the main body of producers, and is 1400 feet deep, and No. 6, which appears to have found a locally rich spot, as it is some distance east of a number of failures. This well is 1809 feet deep, which considering its position on the formation is shallower than either No. 8 or No. 5, which were dry holes at 1810 feet and 1740 feet. Well No. 3, the farthest to the east, was a dry hole at 1740 feet. Well No. 11, located just north of the strike of the anticlinal axis, was carried to a depth of 2281 feet, and is reported to have shown only traces. These results seem to indicate that at least the upper sands, and possibly the lower also, considering the results from No. 11, are not commercially productive this far to the east.

But little information is available as to the former output of the Puente wells, though a table published in 1894 gives the initial output of a number of the older wells. (Bulletin 11, State Mining Bureau, W. L. Watts.)

Well No. 4, drilled in 1885, had an initial output of 10 barrels per day of rather heavy oil, which in 1894 had shrunk to 5 barrels per day, or an annual decrease of about 5 per cent. This well is still on the producing list. Well No. 5, located close to No. 4, shrunk from 25 barrels daily in 1886 to 6 barrels daily in 1894, an annual decrease of about 9 per cent. This well made a much lighter oil than No. 4—about 30° Beaumé.

Well No. 10, at the western end of the group, made only about 1½ barrels of heavy oil, and was never produced. Well No. 7, about 400 feet east, started off in the year 1887 with 35 barrels per day of 30° oil, but in 1894 had dropped to 3 barrels daily—this well is still pumping. Well No. 16, about 300 feet east of No. 7, was drilled in 1891, and started off with 35 barrels of the same quality of oil. In 1894 this had dropped to 8 barrels, and the well is still pumping.

Well No. 12, which is on the north line, started off in 1888 with 35 barrels of a 25° oil. In 1894 this had dropped to 5 barrels, but the well is still producing. No. 14, which is some distance to the southeast, but still on the north line of production, started off in 1889 with 10 barrels daily of heavy oil (probably about 20° Beaumé), and had dropped to 4 barrels in 1894, but is still pumping.

Well No. 15, toward the west center of the group, made 35 barrels daily of a 30° gravity oil, when brought in during the year 1890. In 1894, after four years' pumping, it was still making 25 barrels daily, and is now pumping. No. 13, 500 feet to the northeast, came in during 1889 with 15 barrels daily of 30° oil, and in 1894 was making 5 barrels per day. This well was abandoned as exhausted in the year 1902.

Well No. 8, 450 feet southeast of No. 13, and due east of No. 15, was drilled in 1888, and had an initial output of 19 barrels of 30° oil. In 1894 this had fallen to 4 barrels daily, and the well was abandoned as exhausted in 1908, after pumping twenty years. Well No. 11, 400 feet southeast of No. 8, and close to the center of the group, was drilled in 1888, and produced 12 barrels daily of a 25° oil. In 1894 this had dropped to 4½ barrels per day, and the hole was abandoned in 1904, after pumping sixteen years.

Wells No. 23, 22 and 26 are located near the center of the group, in an east and west direction, but near the southern limit of production, and in a line parallel to the strike. No. 23, farthest to the west, was drilled in 1892, came in at 60 barrels per day of 35° oil, and in 1894 had dropped to 15 barrels daily. No. 22 was drilled in the same year, came in with 150 barrels of the same oil, and in 1894 had fallen to 65 barrels.

No. 26, 900 feet farther east, was drilled in 1893, and had an initial output of 125 barrels of the same oil, which had fallen in one year to 25 barrels daily. These three wells are still producing. Well No. 25, located between No. 23 and No. 22, but about 300 feet to the south, came in with 8 barrels daily of heavy oil, which in one year dropped to 3 barrels per day. This well was pumped for five and a half years, and then abandoned as exhausted. No. 24, located between No. 22 and No. 26, had only a very little heavy oil, and was never pumped.

It appears that where there was some little gas pressure, as in the wells last mentioned, a high initial production was had, but that this broke very rapidly to a small output which was sustained for a long time. Wells showing less gas originally had a smaller initial output, but fell away less rapidly, and finally settled down to about the same figure as the gassy wells.

There are at present on this property, including the Menges wells noted below, 53 producing wells, and 35 abandoned holes. Of the latter 25 were dry holes, or showed only traces of oil, while 10 were pumped for periods varying from one year to twenty years.

The average depth of the producing wells is 1324 feet, with a maximum of 2340 feet and a minimum of 1210 feet. Of these wells, 14 are less than 1000 feet in depth, and 26 more than 1500 feet deep.

The average age of all the producing wells on the property is approximately fifteen and one half years. The present output (year 1911) is reported at 33,000 barrels, or an average of 1.7 barrel per well per day. The quality of the oil is indicated by the analyses at the end of the chapter.

All of these wells pump on the jack, and make almost no sand. Some of the wells produce considerable water, but this appears to be entirely upper water, and is mainly confined to the older wells, where the light casings used have suffered with the lapse of time. This water settles freely from the oil, and there is no water trouble, as this term is usually understood.

The Puente Oil Company also operates a lease in the light oil district of the Olinda field.

Menges Oil Company. On the Grazide tract, now under lease to the Pico Oil Company, and lying east of the Puente wells, the Menges Oil Company drilled a string of test wells across the anticline, in the years 1895 to 1901. Grazide No. 1, far to the southeast, was abandoned at 426 feet, and was presumably a lost hole. Grazide No. 3 is the farthest north of the string of four wells across the anticline, and was carried to a depth of 1900 feet. No. 2, next to the south, to 1876 feet. No. 4 to 1950 feet, and No. 5, the farthest south, to 1244 feet. All these wells were abandoned when drilled, and were then considered to demonstrate

that the formation was nonproductive at this end, as they found only traces of oil.

W. B. Scott Oil Company. The well of this company, drilled in 1910, is something less than one half mile south of the nearest producers of the Puente Oil Company, and slightly closer to the wells of the Orange Oil Company. This hole was carried to a depth of 4275 feet without encountering the slightest indications of oil, and is said to have gone through formation notably different from that in the Puente wells, and yet not altogether similar to that of the Orange wells. This hole may be considered to prove that the failure of the more southerly wells of the Puente was not due to any purely local cause, and that there is no possibility of closing the gap between the two groups of wells.

Buena Vista Oil Company. A company by this name is said to have drilled one of the holes, apparently dry and shallow, near the northeast corner of fractional section 27, 2–10. Nothing is known as to the history of this well.

Morning Star Oil Company or Morningside Oil Company. Near the Buena Vista well above referred to is another hole, said to have been drilled by a company with some such name as above. No information obtainable.

Union Oil Company of California—La Habra. On the north bank of the cañon, in the northeast corner of section 33, 2–10, are two holes drilled by the Union Oil Company about the year 1890. One of these holes appears to have found some showing of oil, but both were abandoned and apparently pulled.

QUALITY OF PUENTE OIL.

As will be noted from the analyses following, the oils of Puente have about the same gravity range as those of Whittier, ten degrees Beaumé. They lie higher in the scale than the Whittier output, but otherwise resemble it strongly.

These oils are characterized by the low yield of light products for any given gravity, no engine distillate appearing below 22° Beaumé, and no gasoline below 25°. On the other hand, the sulfur content is lower than that of almost any other oil in the State, and all the products of the oil come from the crude still in a high state of purity. This gives these oils considerably greater value than the percentage composition shown by the analyses would indicate.

The paraffin in these oils, which is almost always sufficient in quantity to render the lubricating stock useless without filtration, shows much more tendency to crystallize than is usually the case with California oils.

4415.*

Puente Oil Company. Rowland No. 15.

Gravity ..... 21.5° Beaumé

This is a moderately limpid oil, of a brownish-black color, and a mild, sweet odor.

Distillation.

A sample of 125 c.c., distilled from copper, first two cuts dry, last cut in a steam of gas. Distilliation to dry coke.

First cut	20.3 per cent	41.3° Beaumé
Second cut	21.1 per cent	31.4°
Third cut	51.2 per cent	20.1°
Fixed carbon	7.4 grams per	100 c.c.
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	19.0 per cent
Stove oil	33°	20.0 per cent
Fuel distillate	29.3°	16.2 per cent / Slop distillate
Reduced stock	Solid	26.3 per cent \ 20.1°—42.5%
Asphalt	"D"	18.5 per cent, or 64.9 lbs. per bbl.
		100.0 per cent

The heavy distillate was of unusually dark color, and contained so much paraffin that it solidified as it fell from the condenser. The reduced stock was a stiff jelly.

4414.*

Puente Oil Company. Rowland No. 58.

Gravity ..... 22.2° Beaumé

This is a moderately limpid oil of a brownish-black color and a sweet, gassy odor.

Distillation.

Sample of 150 c.c., distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to a residue of dry coke.

First cut	14.1 per cent	42.3° Beaumé
Second cut	25.4 per cent	37.0°
Third cut	52.9 per cent	22.7°
Fixed carbon	7.6 grams per	100 c.c.
	100.0 per cent	

On calculation of the carbon to asphalt, and reduction of the last cut in a stream of gas, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	15.0 per cent
Stove oil	33°	27.5 per cent
Fuel distillate	29.5°	17.9 per cent / Slop distillate
Reduced stock	15.4°	20.6 per cent \ 22.7°—38.5%
Asphalt	"D"	19.0 per cent, or 66.7 lbs. per bbl.
		100.0 per cent

*Analysis by J. P. P.

The light products from this oil ran rather dark, and treated only fairly well. The heavy distillate gave a reduced stock of medium viscosity, a pale color, and free from paraffin.

4416.*

Puente Oil Company. Rowland No. 54.

Gravity ..... 25.2° Beaumé

This is a limpid oil of a brownish-black color, with a mild, sweet odor.

Distillation.

Sample of 175 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distilled to a residue of dry coke.

First cut	6.0 per cent	52.3° Beaumé
Second cut	23.7 per cent	42.1°
Third cut	11.5 per cent	33.0°
Fourth cut	50.5 per cent	24.5°
Fixed carbon	8.3 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the carbon to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	6.5 per cent
Kerosene	42°	23.5 per cent
Stove oil	33°	11.5 per cent
Fuel distillate	29.8°	22.2 per cent) Slop distillate
Reduced stock	14.7°	15.5 per cent (24.5°—37.7%
Asphalt	"D"	20.8 per cent, or 73.0 lbs. per bbl.
		100.0 per cent

The light products from this oil ran pale from the still, and treated out with the test acid to water-white and very sweet oils. The lubricating distillate gave a reduced stock of pale and rich green color, but almost solid with paraffin.

4418.*

Puente Oil Company. Rowland No. 71.

Gravity ..... 26.3° Beaumé

This is a limpid oil, of a black color with greenish tinge, and a mild, sweet odor.

Distillation.

Sample of 100 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to a residue of dry coke.

First cut	9.8 per cent	51.8° Baumé
Second cut	16.1 per cent	42.1°
Third cut	17.2 per cent	32.8°
Fourth cut	50.7 per cent	23.4°
Fixed carbon	6.2 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

On reduction of the last cut in a current of gas, and calculation of the carbon to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None	
Engine distillate	52°	9.5 per cent	
Kerosene	42°	16.5 per cent	
Stove oil	33°	17.0 per cent	
Fuel distillate	32.7°	15.8 per cent	Slop distillate
Reduced stock	14.1°	25.7 per cent	23.4°—41.5%
Asphalt	"D"	15.5 per cent, or 54.4 lbs. per bbl.	
		100.0 per cent	

The light products ran very pale and sweet, and treated out readily to water-white oils. The lubricating stock shows some crystallization, and the reduced stock, though of good color, is quite solid with paraffin.

2422.*

Puente Oil Company. Rowland No. 50.

Gravity ..... 26.8° Beaumé

This is a very limpid, brownish-black oil, with a mild, sweet odor.

Distillation.

Sample of 100 c.c., distilled from glass to a temperature of 518° Fahrenheit. Residue reduced to asphalt by open evaporation, and the weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are as follows:

Below 212° F.	0.5 per cent	
212 to 302°	10.0 per cent	59.2° Beaumé
302 to 518°	28.0 per cent	43.6°
Residue above 518°	59.0 per cent	15.5°
Loss	2.5 per cent	
	100.0 per cent	

After evaporation of the residue to asphalt, and calculation, the above figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	6.0 per cent
Engine distillate	52°	6.0 per cent
Kerosene	42°	26.5 per cent
Middlings and lubricants	---	35.5 per cent (not separated)
Asphalt	"D"	26.0 per cent, or 91.2 lbs. per bbl.
		100.0 per cent

*Analysis by E. N. Moor.

3400.*

Puente Oil Company. Rowland lease, a mixture.

Gravity ---------- 26.8° Beaumé

Distillation.

A sample of 100 c.c., distilled from glass to a temperature of 518° F. Residue from this distillation reduced to "D" asphalt in vacuum. Lubricating stock from this run reduced to a 22.3° stock in vacuum. The results from the three distillations are:

Crude oil.

Below 302° F.	12.5 per cent	58.8° Beaumé
302 to 518°	29.0 per cent	42.4°
Residue above 518°	57.0 per cent	
Loss	1.5 per cent	
	100.0 per cent	

Residue from above.

Lubricating stock	33.0 per cent	27.3° Beaumé
Asphalt	24.0 per cent	Grade "D"
	57.0 per cent	

Lubricating stock from above.

Fuel distillate	15.0 per cent	32.5° Beaumé
Reduced stock	18.0 per cent	22.3°
	33.0 per cent	

On bringing these figures together, they give the following commercial analysis:

Gasoline	61° Beaumé	8.5 per cent (about)
Engine distillate	52°	5.5 per cent
Kerosene	42°	28.0 per cent
Fuel distillate	32.4°	15.0 per cent
Reduced stock	22.3°	18.0 per cent
Asphalt	"D"	24.0 per cent, or 84.2 lbs. per bbl.
Loss	---	1.0 per cent
		100.0 per cent

4417.†

Puente Oil Company. Rowland lease, a mixture.

Gravity ---------- 27.8° Beaumé

This is a limpid oil of a brownish-black color, and a mild, sweet odor.

Distillation.

A sample of 100 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distilled to dry coke.

First cut	13.5 per cent	51.9° Beaumé
Second cut	10.4 per cent	42.7°
Third cut	36.8 per cent	33.1°
Fourth cut	32.1 per cent	24.1°
Fixed carbon	7.2 grams per 100 c.c.	
	100.0 per cent	

*Analysis by Wayne Colver.

†Analysis by J. P. P.

On calculation of the carbon to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	13.5 per cent
Kerosene	42°	11.0 per cent
Stove oil	33°	35.0 per cent
Fuel distillate and lubricants	24.1°	22.5 per cent (not separated)
Asphalt	"D"	18.0 per cent, or 63.2 lbs. per bbl.
		100.0 per cent

The light products from this oil ran very pale and sweet, and treated out of the highest grade products. The lubricating stock was sweet, and of medium color and viscosity.

7475.*

Puente Oil Company. Rowland Nos. 3, 4, 5 and 6.

Gravity ---------- 28.7° (0.882 sp. gr.)

This sample was collected and analyzed in the year 1886, when these wells were less than one year old.

Distillation.

A sample of 500 c.c. was distilled from a copper retort, using neither steam nor gas. Distillation was carried to 300° C., but the properties of the residue were not noted.

Below 100° C.	10.6 per cent	65.2° Beaumé
100 to 125°	8.7 per cent	57.4°
125 to 150°	7.7 per cent	51.6°
150 to 200°	10.2 per cent	44.3°
200 to 250°	7.2 per cent	35.7°
250 to 300°	6.0 per cent	28.9°
Residue	49.6 per cent	Not recorded.
	100.0 per cent	

This is equivalent to the following commercial analysis:

Gasoline	61° Beaumé	20 per cent
Engine distillate	52°	7 per cent
Kerosene	42°	14 per cent
Stove oil	33°	4 per cent (about)
Residue below stove oil	---	55 per cent
		100 per cent

*Analysis by W. D. Johnston.

2426.*

Puente Oil Company. Rowland No. 61.

Gravity	29.1° Beaumé
Viscosity at 70° F.	4.22 Redwood
Flash point	60° F. (open test)
Fire point	98° F. (open test)

This is a limpid, brownish-black oil, with a mild, sweet odor.

Distillation.

Sample of 100 c.c.. distilled from glass to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are as follows:

Below 212° F.	3.0 per cent	
212 to 302°	18.0 per cent	58.2° Beaumé
302 to 518°	24.0 per cent	41.4°
Residue above 518°	55.0 per cent	
	100.0 per cent	

After evaporation of the residue to asphalt, and calculation, the above figures are approximately equivalent to the following commercial analysis:

Gasoline	61° Beaumé	20.0 per cent (about)
Engine distillate	52°	None
Kerosene	42°	22.0 per cent
Middlings and lubricants	---	35.9 per cent (not separated)
Asphalt	"D"	22.1 per cent, or 77.6 lbs. per bbl.
		100.0 per cent

7434.†

Puente Oil Company. Rowland No. 66.

Gravity	29.5° Beaumé
Viscosity at 60° F.	2.35 Redwood
Viscosity at 185° F.	1.23 Redwood
Sulfur	0.36 per cent by weight
Thermal value	19,258 British thermal units

Distillation.

Sample of 200 c.c., distilled from glass flask, without steam or gas.

Below 212° F.	8.0 per cent	62.7° Baumé
212 to 302°	15.4 per cent	51.4°
302 to 392°	9.0 per cent	41.7°
392 to 482°	10.1 per cent	36.4°
482 to 572°	15.0 per cent	31.9°
572° to grade—a	23.1 per cent	28.0°
572° to grade—b	5.7 per cent	28.4°
Asphalt	13.1 per cent	Grade "D" (about)
Loss	0.6 per cent	
	100.0 per cent	

*Analysis by E. N. Moor.

†Analysis by H. N. Cooper.

These figures are closely equivalent to the following commercial analysis:

Gasoline	61° Beaumé	11.0 per cent
Engine distillate	52°	8.0 per cent
Kerosene	42°	14.0 per cent
Stove oil	33°	24.0 per cent
Middlings and lubricants	28.1°	29.3 per cent
Asphalt	"D"	13.1 per cent
Loss	---	0.6 per cent
		100.0 per cent

5416.*

Puente Oil Company. Rowland No. 34.

Gravity ---------- 32.5° Beaumé

This is a very limpid oil of a brownish-black color, with a mild, sweet odor.

Distillation.

A sample of 200 c.c., distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	15.2 per cent	60.8° Beaumé
Second cut	12.4 per cent	52.0°
Third cut	13.5 per cent	42.0°
Fourth cut	17.0 per cent	33.0°
Fifth cut	36.9 per cent	22.6°
Fixed carbon	5.0 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the carbon to asphalt, these figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	15.0 per cent
Engine distillate	52°	12.5 per cent
Kerosene	42°	13.5 per cent
Stove oil	33°	17.0 per cent
Fuel distillate	30.1°	15.3 per cent / Slop distillate
Reduced stock	13.0°	14.2 per cent \ 22.6°—29.5%
Asphalt	"D"	12.5 per cent, or 43.9 lbs. per bbl.
		100.0 per cent

The light products from this crude ran white and sweet, and are of the best quality. The lubricating stock was of good color, and gave a reduced stock of medium to low viscosity, showing only a trace of crystallization.

*Analysis by J. P. P.

CHAPTER XVI.

FULLERTON FIELD.

The title Fullerton is ordinarily applied to the entire group of wells lying along the lower reaches of Brea Cañon, and on the hills to the east, in the northern portions of townships 3 S. 10 W. and 3 S. 9 W. The Puente wells are by general consent omitted from this group.

The western portion of this district, from the west line of section 2, 3–10 to the east line of the Union Oil Company's Sansinena property, sections 6 and 7, 3–9, is often considered separately under the name Brea Cañon, while the wells east of this limit and extending into section 10, 3–9, are known as the Olinda wells. This division originated at a time when the older wells, those near the mouth of the Brea Cañon and at Olinda station, were separated by a wide stretch of undrilled territory, and has since been shown to be quite arbitrary, later developments having covered the intervening ground without discovering any material variation in underground conditions. It is here retained as a matter of convenience, and it will be understood that, as here used, the name Fullerton covers the entire field; Brea Cañon the wells on and to the west of the Sansinena and Stearns tracts, and Olinda the wells east of this boundary.

Topography. The Fullerton field lies on the foothills of the Puente range. To the northwest of the field, where the Puente wells are located, the trend of the hills is east and west, and the hilly strip is narrow, not more than two miles in a north and south direction intervening between Chino and La Habra valleys. But to the northeast and east of the field the hills are rougher and cover a much wider territory, the distance from the mouth of Telegraph Cañon to the flat land near the town of Chino being about eight miles. The hills at this point take a southeasterly course.

Brea Cañon penetrates this hill range, with a course generally from northeast to southwest, but near the east line of township 3–10 it turns to the west, then to the northwest to the point where it is joined by Cañada del Rodeo, then west again, and finally turns south to La Habra Valley. West of the mouth of the cañon is an abrupt spur, making off from the main range in a southwesterly direction—some of the best wells in the field are located on this spur.

East and south of Brea Cañon is a hill some four hundred feet in height and about two miles long, its northern face rising abruptly from the cañon bed, while the southern slopes off gently to the valley. The earlier wells at this end of the field were on the northern face and the apex of this ridge, but drilling has now been carried some distance down the southern slope.

At its eastern end this hill merges in the southwesterly slope of the main range. On sections 8 and 9 the surface slopes to the southwest, directly to the valley, but Soquel and Telegraph cañons enter near the southeast corner of section 9, the town of Olinda being situated in a little pocket, and separated from the valley on the south by a low ridge. Drilling has been carried over this southwest slope as far back as the northeast corner of section 8 and the east line of section 9, and has also been continued over the ridge, at its western and lower end. The surface of the field as a whole is smooth and accessible, though the hills immediately back of the developed portion are quite steep and rough.

Underground Structure. The geology of this country was fully covered, at least so far as it was known at that time, in Bulletin 309 of the United States Geological Survey (Geo. H. Eldridge). It need here be described in only the most general manner.

The Brea Cañon sands approach the surface near the center of the northwest quarter of section 1, dip toward the southwest, and have been proven up for a distance of one and one quarter miles east and west, and about one half mile north and south. Several sands are found at various depths, these lying from 500 feet to 2000 feet below the surface on the northwest quarter of section 1, and from 1700 feet to 2600 feet at the western end of the strip. These sands all produce a moderate gravity black oil. Below these layers a deeper sand has been found in two or three wells (notably in Bireh No. 5) at depths ranging from 3000 to 4000 feet. This sand flows large quantities of a very light oil, under high gas pressure.

The limits of this group are set on two sides only. On the north, a zone of faulting follows in a general way the south line of Rancho Puente, the formations north of this fault being of a quite different character from the producing formations to the south, and apparently entirely barren (see W. B. Scott Oil Company). At the eastern end of the group the sands become but slightly productive as they approach the surface, though it is not certain that some extension may not be made to the east or the northeast (see Edison Oil Company).

No limit has been indicated to the west, but if the present rate of deepening persists in that direction no great extension is possible. On the south, the 4200-foot dry hole of the Syndicate, on the north line of section 11, sets a limit one half mile south of present developments, and it is certain that the sands are within reach over at least a part of the intervening distance.

The sands underlying the ridge south of Brea Cañon, on sections 1, 6 and 7, dip to the south or southwest, and are faulted away in the bed of Brea Cañon, several attempts to the north of this line having resulted in failure. Developments are still going south and southwest, but have already reached a considerable depth.

East of the southeast corner of section 6 the fault line takes off to the north, but a sharply folded or faulted anticline continues in the same direction to the east, across the northern part of section 8. Only a few wells have been drilled on the north limb, which dips steeply and has not been very productive.

The south limb forms practically a monocline, dipping generally south a little west, but with minor flexures, and covering almost the full depth of section 8. Several sands are found at different depths, ranging from 800 feet to 1500 feet on the east line of the section, and from 1300 feet to 3350 feet on the southwest quarter. In general, the lower sands make a heavier oil than the upper, and along the south line of developments all the oil is heavy. Considerable water is produced with the oil on this side the field.

No limit has been set at the southwest, except by Graham-Loftus No. 27, which found some oil, but had too much water to handle. It is highly probable that some at least of the intervening space will later be drilled. Developments are still going to the south, with no limit set, but at the southeast corner the Olinda Crude thoroughly tested the ground, and found it nonproductive.

The long and narrow string of wells extending across section 9 is in a different and older formation. These wells were drilled in highly disturbed rocks, practically in a fault zone, and produce a lighter oil than the sands farther west, from layers of firm sand or sandstone.

With this one exception, the oils of Fullerton are found in beds of sand, which are generally rather coherent. For this reason very little sand is produced with the oil, and this mainly along the southern margin of the field.

Brea Cañon Wells.

One hundred and five wells have been drilled in the Brea Cañon division of the field, of which seventy-four are producing, eleven were drilling in January, 1912, and twenty had been abandoned. The records of these developments, so far as obtainable, are as follows:

Cornerstone Oil Company. A company under this name is said to be drilling on the northeast corner of section 4, 3–10.

Orange Oil Company. This company has three wells on an irregularly shaped tract in the north half of section 2, 3–10. Well No. 1, the farthest to the west, was drilled in 1908, and is a fair pumping well at 2685 feet. Well No. 2, some distance to the east along the south property line, was drilled in 1909, and is 2900 feet deep. This was for a long time a flowing well, and an excellent producer, being rated at 300 barrels daily. Well No. 3 was started in 1910, and at last reports was drilling at 3240 feet.

Pico Oil Company. This company has two wells on an irregular tract in the northeast quarter of section 2, 3–10. In No. 1 the casing

collapsed at 1750 feet, and the hole was abandoned. Well No. 2 was drilled in 1910, and was a heavy producer at 2825 feet, flowing upwards of 600 barrels per day of an oil of 27.5° Beaumé.

Crown of the Valley Oil Company. The well of this company, on the property now owned by the Pico Oil Company, was drilled in 1901, and abandoned as a dry hole. It is said to be about 1800 feet deep.

Edison Oil Company. This well was located at the eastern extremity of the Pico property, just south of the line of Rancho Rincon de la Brea. It was drilled in 1900, and carried to a depth of 860 feet. At this depth it flowed some sixty barrels of oil, but the light casing collapsed, pinched the tubing and let upper water into the sands, upon which the hole was abandoned.

Fullerton Oil Company. The Brea Cañon lease of the Fullerton Oil Company is an irregular tract in the north half of section 2, 3–10. On this there are nine wells, all but one of which are producers.

Well No. 1, drilled in 1907, is a producer at about 2100 feet. Nos. 2 and 3, drilled in 1908, are producers at 2500 feet and 1700 feet respectively. Well No. 4 is still drilling, now down some 800 feet, having had much trouble with lost tools.

Well No. 5 is a producer at about 3400 feet, and No. 6 at about 3300 feet. No. 7 produces from about 2675 feet, and No. 8 from 2670 feet. Well No. 9 is a producer at some 3400 feet. It is said that in this well no oil was found above the 3300-foot level.

These wells all pump on the beam, and make a very light oil, similar to that from the Orange and Pico leases. The Fullerton Oil Company also operates properties in section 9, 3–9, Olinda field, and section 25, 2–11, Whittier field.

Birch Oil Company—Menges Oil Company. The old lease of the Menges Oil Company in the northeast quarter of section 2, 3–10, is now owned and operated by the Birch Oil Company. On this tract there are five producing wells and three drilling.

Well No. 1 of the Menges was the first well completed west of Brea Cañon. It was drilled in 1900, and is a producer at 1630 feet. Well No. 2 was drilled in 1904, and is also on the beam at 2430 feet.

Well No. 3 was drilled in 1907, and produces from the 2550-foot level. Well No. 4 was drilled in the following year, and is almost exactly the same depth, 2440 feet. These wells all draw from an upper sand, and produce a moderately light oil, somewhat like that of the Brea Cañon Oil Company's lighter wells.

Well No. 5 was finished in 1911, and was a large flowing well at 3940 feet. This well has been a remarkably steady producer, and is still doing about 2400 barrels per day. The gravity of the oil is higher, 27.9° Beaumé, and the oil is accompanied by a large amount of gas. Wells No. 6, 7 and 8 are now drilling (June, 1912).

The Pacific Gasoline Company operates a compressor plant on this lease for the manufacture of gasoline from the excess gas, of which there is a large quantity. This plant is said to have been more than usually successful.

Brea Cañon Oil Company. This company was the pioneer in the Brea Cañon field, having commenced operations in the year 1900. The property of this company is an irregular tract in the east half of section 2, 3–10 and the west half of section 1, 3–10. On this property there are twenty-six wells, of which twenty-two are producing, three are abandoned, and one is drilling (March, 1912).

Well No. 1 is a producer at 1011 feet, and in spite of its age is said to be still doing about seven barrels per day. Well No. 2 was a spoiled hole (lost tools) at 1350 feet. Well No. 3, which is only 500 feet deep, was pumped for ten years, but lately abandoned as exhausted. This is the farthest east of any well on the lease, and very close to the upper edge of the sands.

Only scattering information is available as to the wells up to No. 15. These wells are all on the eastern side of the property, and are all producers. Wells No. 11 and No. 12 are flowing wells, the balance are on the pump. The output for the ten wells from No. 4 to No. 13 is said to average 18 barrels per well per day. Well No. 4 is 1650 feet deep, No. 5 is 1200 feet, No. 6 is 1500 feet, No. 7 is 1470 feet, No. 11 is 1250 feet, No. 12 is 1518 feet, and No. 13 is 2655 feet deep. No. 14 is said to be a better producer, averaging 30 barrels per day.

Well No. 15 is 1486 feet deep, No. 17 is 2200 feet, and No. 18 is 1100 feet deep. The output of these four wells is said to average 12 barrels per well per day. No. 19 is a producer at 2000 feet and is said to be good for about 25 barrels daily, while Nos. 20 and 21 are good for about the same amount.

Well No. 22 was carried to 3002 feet, and made 60 barrels daily. The output of this well is about the same as that of No. 24, which is only 2200 feet deep. Well No. 23 was a spoiled hole (lost tools). No. 25, drilled in 1910, was 2000 feet deep, and No. 26 was still drilling at last reports.

The oil from these wells runs from 18° to 24° Beaumé, and averages about 21°. The heaviest oil and smallest production is at the upper edge of the formation, at the northeast corner, the lighter oil and larger productions to the southwest. Neither the depth nor the output increases very rapidly in this direction, and the test made on No. 22 apparently discouraged further search for a deep sand, as the later wells have been finished at a slight depth.

Olinda Wells.

Delaware Union Oil Company—Graham Loftus Oil Company. The tract in the south half of section 2, 3–10, formerly owned by the Graham-Loftus Oil Company, passed to the Delaware Union Oil Company during 1911.

On this tract there are five wells, of which two were producing and three drilling when last visited. The depth of the producing wells is not certainly known, but is said to be in the neighborhood of 2500 feet. They produce an oil of about 18° Beaumé.

Syndicate Petroleum Company. The well of this company is on the west side of Brea Cañon, on the north line of section 11. It was drilled in 1910 to a depth of some 4200 feet, and was abandoned. It is said to have been barren.

Union Oil Company—Sansinena Tract—Stearns Tract. The Sansinena lease covers a large area in sections 1 and 12, 3–10, and in sections 6, 7 and 8, 3–9 (see field map). The Stearns lease lies just to the south, in sections 7, 3–9 and 12, 3–10. On these tracts there are fifty-three wells, of which thirty-six are producing, ten have been abandoned, and seven were drilling in January, 1912.

These wells lie in two groups, the western, next to the Brea Cañon property, and including Nos. 1, 2, 9, 10, 11, 12, 13, 18, 19, 20, 22 and 25, producing a light oil from a slight depth, while the balance of the wells, along the creek and on the hills to the south, make a much heavier oil. The output from the wells immediately in the creek bed, which are in the Brea Cañon fault or just to the south of this line of disturbance, is somewhat more viscous than that from the deeper wells just to the south, though a tendency toward increase in weight and viscosity is noted in passing from these latter wells to those farthest south on the lease.

The first two wells were respectively 1000 feet and 1300 feet deep, and were only small producers when new. No information can be had as to the later wells in this group, but it is probable that they are of about the depth of the Brea Cañon wells just west, and they appear to be small producers. All these wells are pumping except No. 11.

The earlier wells in the eastern group were drilled in the creek bed, where there is a large brea deposit on the south bank, and some indication of faulting. These wells are shallow, few over 1500 feet, and the oil is very heavy on this side, about 15° Beaumé. The production of these wells has fallen to a very low figure, and several have been pulled out. Well No. 30*a*, situated north of the creek bed road, was a fairly deep hole, and is said to have been entirely dry.

Farther south the wells are much deeper, but the depths are very irregular. Thus, taking approximately straight lines east and west,

No. 41 is 3698 feet, No. 44 is 3840 feet, No. 42 is 2865 feet, No. 37 is 2980 feet, and Nos. 38 and 39 are each 3080 feet. In the next line south, No. 43 is 3300 feet, No. 42 is 3200, No. 36 is 2400, and No. 35 is 1990 feet. Four wells along the south line of the Sansinena show: No. 46, 3249 feet, No. 34, 3475 feet, No. 33, 2700 feet and No. 32, 3600 feet. Lacking any further information, the bearing of this wide variation in the depths of adjacent wells can not be known.

Nine of the wells in this group are abandoned, Nos. 4, 5, 7, 16, 23, 24, 30, 30*a* and 31. All of these were at one time productive except No. 30*a*. The gravity of the oil produced increases slightly toward the south, being about 16.5° Beaumé on the south line of development.

Puente Crude Oil Company. This company drilled two wells in the endeavor to find production north of Brea Cañon. These wells were both abandoned when drilled.

Well No. 1 is located on Brady land, in the northwest corner of section 6, 3–9. It was drilled in the year 1895, and abandoned as a crooked hole at 675 feet.

Well No. 2 was farther up Cañada del Rodeo, in the southwest quarter of the southwest quarter of section 31, 2–9. This well was drilled in the same year, and was carried to a depth of 2135 feet. It is said to have found traces of both oil and gas, but in a formation entirely different from that found south of Brea Cañon.

Columbia Oil Producing Company. This company has twenty-two wells on an irregular tract in the northwest quarter of section 8, 3–10, of which nineteen were producers, and three drilling, at last reports.

These wells are divided into two groups, the numbers from 1 to 12 being in the northern portion of the tract, close to the section line, while later numbers are on the south line, and along the southern third of the east line, next to Industrial and Santa Fé wells.

The wells in the northerly group are all shallow, ranging from 650 feet on No. 6 to 1400 feet on No. 7. Like the wells farther west, the depth gives no indication of the level at which the sands lie: for instance, taking an approximately straight line across the group: No. 1 is 1050 feet deep, No. 2 is 800 feet, No. 5 is 850 feet, No. 7 is 1400 feet, No. 8 is 700 feet, and No. 10 is 1050 feet. No. 7, however, is a much larger producer than the other wells in this group, and has without doubt been carried into a deeper sand than any penetrated in the other wells.

These wells were at one time excellent producers, said to be good for an average of fifty barrels per day, though they are believed to be considerably depreciated at this time. The gravity of the oil lies close to 19.5° Beaumé.

The more southerly wells are very much deeper, running from 2400 to 3200 feet, with an average of about 2900 feet. These wells are also

much larger producers, some of them going as high as five hundred barrels per day when new. The gravity of the oil from this end runs from 20° to 20.5° Beaumé.

Toward the southern end of this tract the sands show considerable water, which is pumped with the oil, and separated by the heating method mentioned below. This water does not emulsify, and as the oil is heated by means of gas from the wells, separation of water is a matter of small expense.

Industrial Oil Company—Fullerton Consolidated Oil Company. The Industrial Oil Company operates a large and irregularly shaped tract in the south half of section 8, 3–10, south of Columbia and Petroleum Development property, and north of Olinda Land Company. This property was developed and operated by the Fullerton Consolidated Oil Company up to 1910, in which year it was sold to the Industrial Oil Company. In July, 1912, this property was reported as again sold to the West Coast Oil Company (see Salt Lake field), but the report is not verified.

Only scattering information is available as to these wells. Of the four abandoned wells, No. 8 was pulled in 1902—spoiled hole; No. 13 was converted into a water-well, and Nos. 17 and 30 were drowned out.

Well No. 1 is 2300 feet deep, No. 4, drilled in 1900, is 1970 feet, and No. 5 is 2300 feet deep. This latter well is said to be capable of producing 20 barrels daily of 20.5° oil.

Well No. 9 was drilled in 1902 to 2200 feet, and No. 10, 1780 feet deep, is said to produce 10 barrels per day of 15.9° oil. No. 12 is 2000 feet, No. 14 is 2700 feet, No. 15 is 2800 feet, and No. 16 is 2735 feet, the three latter reported as making 120, 80, and 90 barrels daily, respectively.

Well No. 19 is 2860 feet deep, No. 20 is 2200 feet, and No. 21 is 2900 feet. No. 20 is rated at 300 barrels per day of 18.5° oil. No. 23 is 2890 feet. No. 24 is 3120 feet, and No. 25 is 2270 feet.

Well No. 28, 3190 feet deep, is credited with 180 barrels per day of 20.9° oil, and No. 29, at 2870 feet, with 200 barrels per day of 14.7° oil. These production figures date from 1910, and are probably over the truth at the present time (July, 1912). They are noted as illustrating the wide diversity in gravity and output from adjacent wells in this part of the field.

The heavier oil from these wells, and particularly from the southern end of the lease, carries a great deal of water, which does not emulsify, and is readily removed by heating and settling. The heating is done by a simple and effective apparatus, sometimes called a roaster, and constructed in a general way as follows:

A tunnel of red brick is built, some five feet wide and high, and perhaps thirty feet long. This tunnel is open at the ends, has a stack at its

middle point, and is covered by sections of old well-tubing, cut to a length to reach across, from wall to wall, laid side by side and chinked with clay. These sections of tubing are not closed at the ends, as circulation of air through the tube is depended on to prevent them from sagging, but even with this precaution, the tubes directly over the fire last but a short time. The advantages of this method are, simple and cheap construction, and ready access to the inside of the tunnel at any point.

This tunnel is filled with a continuous box-coil of three-inch or four-inch pipe, through which the oil to be heated is pumped, the outlet end discharging freely into a tank or sump. The tunnel is fired with gas from both ends, products of combustion passing to the stack at the center. By regulation of pump speed and fires the oil may be heated to any temperature desired. These heavy and nonvolatile oils are usually heated sufficiently to cause the water to boil at the outlet of the coil. The oil thus heated settles readily and clear, and it is not necessary to actually boil off any appreciable portion of the water. There is, of course, some loss from evaporation of the heated oil, but this is small with an oil of this gravity, and there being no expense for fuel, operating costs are very low. With an oil much lighter than this, a condensing attachment would be necessary to prevent heavy loss of the lighter constituents of the oil.

Delaware Union Oil Company—Graham-Loftus Oil Company. The property of the Graham-Loftus Oil Company, the north half of the northeast quarter of section 8, and the northwest forty acres of section 9, 3–9, was sold during 1911 to the Delaware Union Oil Company. This transfer also included the leases in the northwest quarter of section 17, 3–9, also in Olinda, and in section 8, 3–10, in the Brea Cañon field.

The well in the northwest quarter of section 17 was a deep hole, and was drilled in the hope of finding an extension of the heavy oil sands of section 8 in this direction. It did develop some oil, and was reported as a producer, but the water was never shut off, and it has been suspended for some time.

On the south line of Brea Cañon, in the southeast corner of section 6, 3–9, is a well drilled by Graham & Loftus in 1898. This well is said to have been about 1000 feet deep, and was a dry hole.

On the old Olinda lease, in the northeast quarter of section 8 and the northwest forty acres of section 9, are thirty-seven wells, of which twenty-six were producing, five abandoned, and six drilling when last visited.

The data as to these wells are scanty, only a few of the depths being known, and very little as to productiveness. The wells along the south line of the property are slightly deeper than the Santa Fé wells across

the line, the formation here dipping gently to the north, but here also there are several sands, the deeper being more productive. These wells give an oil of from 21° to 22° Beaumé. Farther north there is some sort of underground disturbance, north of which there is no production. Two or three of the abandoned wells were north of this line, and were dry holes. The wells farthest north which produce give a much heavier oil, from 16.5° to 18° Beaumé. These wells are about 2800 feet deep, on the average.

Petroleum Development Company (Atchison, Topeka & Santa Fé R. R.). The oil properties of the Atchison, Topeka & Santa Fé R. R. Company are operated under the name of the Petroleum Development Company. Beside the Fullerton property, this company has operating leases at Kern River, and in the Midway field.

The Olinda property of this company includes the southeast quarter of the southwest quarter of section 5; a portion of the east half of the northwest quarter, the south half of the northeast quarter, and the northeast quarter of the southeast quarter, of section 8; and the northwest quarter of the southwest quarter and the south half of the northwest quarter of section 9, 3–10.

On this property there were, when last visited, sixty-five wells, of which eight were at that time drilling, three abandoned, and fifty-four producing. Since that time several of these drilling wells have been finished, and others started, the highest number at the beginning of the current year being in the seventies.

Through the courtesy of the Santa Fé Company, very full information is available as to the wells on this property, and as conditions on various portions of this tract are an indication of similar conditions over the greater part of the Olinda field, these notes are given below in some detail.

The wells on the Santa Fé property may be divided into four groups, differing notably in depth, yield and character of oil. The first group consists of the eleven shallow wells, numbered from 1 to 11, including No. 5*a*, but excluding No. 8. These wells are located at the upper end of the town of Olinda, around and east of the machine shops.

The second group includes all the wells along the Graham-Loftus line, and also Nos. 29 and 30, south of this line. These wells produce from the same formation as the Graham-Loftus wells.

The third group includes all the wells on the west and south lines, adjoining Columbia and Industrial property. These wells show something as to the behavior of the heavy-oil formation to the southwest.

The fourth group takes in the wells on the extreme east of the tract, adjoining Puente and Fullerton properties. These wells are in the light-oil formation.

The wells in the first group were drilled in 1907, with the exception of No. 11, which was drilled in 1909. These wells are therefore some fifteen years old, but all are still producing with the exception of No. 4, which was a lost hole at 405 feet. Near No. 11, the most westerly of these wells, there was formerly a small brea deposit, and one is still visible at the east end of the group, between Nos. 7 and 9. These early wells were drilled on the strength of the indication afforded by these seepages, and were carried into the first sand only, being all very shallow. No. 11 is the shallowest well in the group, 460 feet, and No. 9 the deepest, 911 feet; the balance range between 750 and 875 feet.

These wells produce an oil of about 19° Beaumé. They are all pumped on the jack, and are very small producers, the average output for the eleven being about three barrels per well per day. The dip of this surface formation appears to be to the east, but is slight, and not very regular.

The wells of the second group were drilled at different times, and to different depths, some penetrating only the upper sand, some a second, while the later wells appear to have had a third and more productive stratum at greater depth.

Nos. 12, 15 and 19 are first-sand wells, and were drilled in 1899 and 1900, being thus about twelve years old. They are 1095 feet, 1150 feet and 1266 feet deep, and average about two barrels per well per day.

Nos. 13, 17 and 20 were drilled between 1898 and 1901, and are thus of about the same age as the foregoing. They appear to have been carried into a second sand, being 1550 feet, 1725 feet and 1701 feet deep, and make an average of four barrels per well per day.

The third-sand wells are Nos. 14, 16, 29 and 30. These wells were drilled between 1897 and 1904, and were all between 2134 feet and 2200 feet deep. In 1909 No. 29 was deepened to 4310 feet, but without result in the way of increased production, the output from this well being about 12 barrels daily, while the other three are averaging twenty-one barrels per well per day.

Nos. 57, 56, 55, 53 and 54, lying to the west of the above, appear to have been carried into the same sand, though they are somewhat deeper. No. 57, the farthest east, is 2350 feet deep, and from here the depths increase evenly to No. 54, farthest to the northwest, which is 2743 feet deep. These wells were drilled in 1909 and 1910, and are making an average of about ninety barrels per well per day, No. 53 being a much better producer than the others.

The gravity of the oil from all the wells east of No. 17 runs quite even at about 20.5° Beaumé. Farther to the west it rises slightly, to a maximum of 21.8°. The formation appears to dip to the north along the south line of the Graham-Loftus tract, and to the northwest at the west corner of this property.

The three wells at the extreme northwest, Nos. 37, 48 and 43, were drilled in 1905 and 1906. These wells run from 3356 feet to 3755 feet in depth, and average about fifty barrels daily output.

The six wells immediately south of these, on the west line, Nos. 42, 45, 46, 58, 49 and 50, were drilled in the years 1905 to 1908. These wells range from 2340 feet to 2815 feet deep, the depth increasing toward the south. They make an oil of 22° gravity, and produce from 95 to 200 barrels daily, the average being about 140 barrels per well per day.

The two wells in the corner, Nos. 51 and 52, were drilled in 1908, and are considerably deeper than the wells either north or east, and from 550 feet to 650 feet deeper than Columbia No. 13, and Industrial Nos. 16 and 14, the adjacent wells to the south and west, being 3359 feet and 3283 feet deep. Deeper drilling evidently did not prove successful, as their production runs about 150 barrels each, no greater than that of adjacent shallower wells.

Along the south line there is a notable divergence in depth, one well being very shallow, two somewhat deeper, and a number still deeper. No. 25, about midway of the south line, was drilled eleven years ago, and is still good for ten barrels per day from a depth of 675 feet.

Nos. 41 and 23 were drilled in 1901 and 1903, and carried to 1291 and 1344 feet, respectively. These wells are good for about fifteen barrels each daily.

The balance of this string, Nos. 47, 31, 26, 24, 22, 27 and 34, were drilled between 1901 and 1905, and range in depth from 1940 feet to 2610 feet. The deepest wells are at the ends of the string, all the intermediate wells being close to 2000 feet in depth. The productions of these wells vary widely, from twenty to one hundred and fifty barrels per day, and average about sixty barrels.

The oil along the west and south lines is very uniform in quality, ranging from 20.3° to 22.0° Beaumé.

The wells in the fourth group, at the extreme east of the property, are all in the same light-oil formation from which the wells of the Fullerton Oil Company and the Puente Oil Company (Olinda lease) produce. These wells are eleven in number, nine being producers. The two abandoned wells are, No. 8, drilled to 540 feet, and converted into a water-well, and No. 38, far to the northeast of the other wells, a dry hole at 3087 feet.

The first of these wells was drilled in 1901, and the last in 1905. The depths vary between 1165 feet and 2875 feet, but there is not, as in the territory farther west, any correspondence between the depth and the productiveness, nor does the depth to which drilling has been carried give any indication as to the lay of the sands, the wells on this, as on the Puente and Fullerton tracts, varying materially from location to location. The productiveness of these wells varies from one to twenty

barrels per day per well, with an average for the entire group of about ten barrels per well. This oil is all of a high gravity, ranging from 32.5° to 34.5° Beaumé.

Fullerton Oil Company. Beside the Brea Cañon lease, this company owns and operates a tract in the light-oil district of Olinda, the northeast quarter, and a portion of the southeast quarter of the southwest quarter, section 9, 3–9. On this there are twelve wells, all producers. These wells were drilled in the years 1900 to 1907. Like the Santa Fé light-oil wells, these holes vary widely and quite irregularly in depth, the shallowest hole, No. 4, being but 700 feet deep, while Nos. 5 and 9 are the deepest—2500 feet. There is no apparent correspondence between depth and productiveness.

Well No. 1, which has been pumping for 12 years, is said to be reduced to an output of one half barrel daily. No. 9, which is by far the best producer on the lease, and is the only well on the beam, is good for eighteen barrels daily. The other wells are on the jack, and average in the neighborhood of ten barrels daily per well. The gravity of this oil ranges from 32° to 34° Beaumé.

Puente Oil Company (Olinda tract)—Columbia Oil Producing Company. On the southeast quarter of section 9, 3–9 the Puente Oil Company has a compact group of forty-three wells, of which twenty-five are producing, fifteen have been abandoned, and three were drilling when last visited. The first sixteen wells on this tract were drilled by the Columbia Oil Producing Company, on a lease from the Puente, but the property reverted to the Puente in the year 1903.

These wells, like the foregoing, show no correspondence between depth and output, nor does the depth appear to give any indication as to underground structure. In fact, it is quite probable that all these wells are drilling into broken formation, as the logs of adjacent wells vary entirely in many cases. The strip at this end is narrower than at the northwest, and appears to have been marked by a succession of failures, except at the east, where there is a possibility of extension.

The first four wells were drilled in 1898, and are abandoned, but the reason for abandonment is not known. Five were pumped for from six to nine years, and abandoned as exhausted, these being Nos. 8. 10, 11, 13, and 14. Nos. 20, 30, 31, and 35 were drilled to the depth of adjacent holes, but found no oil and were abandoned as dry holes. No. 35, which was a test well, far to the southwest of the other wells, was carried to a depth of 4123 feet, and is said to have had no traces whatever of oil. No. 39, the farthest to the south, was abandoned at 802 feet, after finding a little oil, but no commercial quantity.

The depth of the producing wells varies widely, from a minimum of 660 feet to a maximum of 3028 feet. These depths follow no regular

order, except that the holes at the south end are somewhat the shallower.

The oil from these wells shows a wider range of gravity than that from the Fullerton Oil or Santa Fé light-oil wells. Well No. 40, which is near the south end of the strip, at the west side, gives an oil of gravity 22.2° Beaumé. No. 32 produces an oil of 29.1° Beaumé. The balance of the samples from this lease ran in the neighborhood of 33° to 34° Beaumé.

Continental Oil Company. On the northwest quarter, northwest quarter, section 10, 3–9, on property owned by the Continental Oil Company, is an old hole which is said to be about 1500 feet deep. This hole has been pulled, and now stands full of sulfur water. There are no signs of oil around the location, but nothing can be learned as to the history of this well.

Soquel Cañon Oil Company. A well was drilled by this company on the southwest quarter, northwest quarter, section 10, 3–9, in the year 1900. This well was reported at the time to be 715 feet deep, but is understood in the field to be about 1250 feet. It was abandoned because of lost tools, and made no discovery.

Rob Roy Oil Company. This well was drilled in the year 1904, in the forks of Carbon and Soquel cañons, in the southwest quarter, northwest quarter, section 11, 3–9. It was carried to a depth of about 2000 feet, and is said to have been an absolutely dry hole, so far as oil is concerned.

Olinda Land Company—Olinda Crude Oil Company. The Olinda Land Company owns a large tract in sections 8, 9, 10, 15, and 16, 3–9, and on this two series of wells have been drilled, the first by the Olinda Crude Oil Company, the second by the present owners of the property.

The first series consisted of five, or possibly more wells, about which very little can be learned. Of the two holes on the west line of section 10, south of the Soquel Cañon wells, the more northerly was carried to 1700 feet, but getting into mechanical difficulties, was abandoned and pulled. The second was drilled to 1462 feet, and suspended, but in January, 1912, was again being worked on. The southern well had a very good showing of oil, and it is said that the abandoned well also had enough oil in sight to warrant taking it deeper.

Two wells were also drilled south of the Fullerton Oil Company's property, and one west of the railroad, south of the Santa Fé tract. One of these wells, but which one is not known, was carried to a depth of 3552 feet, and is said to have had some oil near the bottom, but the water could never be shut off, and it was finally abandoned. The other two wells were of moderate depth only, and developed nothing. These wells were all drilled between 1900 and 1905.

The five wells of the Olinda Land Company were started in 1909 and

1910, and when last visited but two of these had been finished, Nos. 1 and 3. These were 2460 feet and 3570 feet deep, respectively, and were producing a heavy oil on the beam.

Iowa Oil Company. This company drilled two wells, in the years 1902 to 1906, on the southeast quarter, southwest quarter, section 16, 3–9, over a mile south of any other developments.

Well No. 1 was drilled with a rotary, and abandoned at some 600 feet because of mechanical difficulties. No. 2 was carried to 3170 feet, and got encouraging showings at 2600 and at the bottom, but had no commercial production, and the operators were unable to carry the hole deeper. It was abandoned and pulled.

QUALITIES OF FULLERTON OILS.

The oils of Fullerton cover a wider range of gravity than those of any single field in the southern portion of the State, unless we so consider the many little pools of the Ventura–Newhall group. The samples whose analyses are given on following pages range from 15.0° to 34.5° Beaumé, a variation of 19.5°, as against 9.8° for Whittier; 6.9° for Los Angeles; 11.6° for Salt Lake; 4.5° for Cat Cañon, and 13.5° for Santa Maria.

Five clearly separated qualities of oil may distinguish in the aggregate of crude from this group, the first being the heavy oils of the southwestern part of the field, from 15.0° to 16.5° Beaumé. These oils closely resemble the oils of the City field, giving no naphthas nor kerosene, and containing considerable sulfur.

A second quality ranges from 16.5° to 19.0°, and is found in all parts of the field. These oils yield, as a rule, considerable kerosene but no naphthas, though in Brea Cañon oils of this gravity show some engine distillate.

A third quality ranges from 19.0° to 22.0°, and resembles average Whittier oil except in containing much more sulfur. These crudes are also found in many parts of the fields—they yield some engine distillate, but little or no gasoline, and are of almost no refining value.

The lower-sand oil from Brea Cañon runs from 27° to 28° Beaumé, and gives a good yield of gasoline. It is much less sweet than the lighter Puente oil, which otherwise it much resembles.

The lightest oil in the field is produced by the wells on section 9. These oils give an unusually high yield of gasoline, even for the gravity, and are probably not excelled in refining value by any oils produced in quantity in the State.

In general, the oils of Fullerton contain more sulfur than those of Whittier and Puente, but this percentage varies widely from well to well, and not, so far as can be seen, in any direct relation to the gravity of the crude.

7433.*

Union Oil Company. Sansinena No. 5.

Gravity ---------- 15.0° Beaumé
Viscosity at 185° F. ---------- 5.18 Redwood
Flash point ---------- 153° F. (Abel-Pensky test)

Distillation.

Sample of 200 c.c., distilled from a glass flask, without the use of steam or gas.

Below 392° F.	5.2 per cent	40.8° Beaumé
392 to 482°	11.6 per cent	31.9°
482 to 572°	25.1 per cent	27.0°
572° to grade	28.5 per cent	27.1°
Asphalt	28.4 per cent	Grade "D" (about)
Loss	1.2 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	4.0 per cent
Stove oil	33°	12.8 per cent
Middlings and lubricants	27.0°	53.6 per cent (not separated)
Asphalt	"D"	28.4 per cent
Loss	---	1.2 per cent
		100.0 per cent

2445.†

Fullerton Consolidated Oil Company (Industrial). Well No. 10.

Gravity ---------- 15.9° Beaumé

This is a moderately thick, black oil, with a mild odor.

Distillation.

Sample of 100 c.c. distilled from glass to a temperature of 518° Fahrenheit. Residue reduced to asphalt by open evaporation, and weight of asphalt corrected (factor x 0.8) for oxidation during evaporation. The original figures are as follows:

Below 302° F.	1.0 per cent	
302 to 518°	14.0 per cent	36.0° Beaumé
Residue above 518°	83.0 per cent	13.1°
Loss	2.0 per cent	
	100.0 per cent	

After evaporation of the residue to asphalt, and calculation, the above figures are roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	5.0 per cent (about)
Stove oil	33°	10.0 per cent (about)
Middlings and lubricants	---	51.4 per cent (not separated)
Asphalt	"D"	33.6 per cent, or 117.9 lbs. per bbl.
		100.0 per cent

*Analysis by H. N. Cooper.
†Analysis by Wayne Colver.

5415.*

Union Oil Company. Sansinena No. 46.

Gravity ---------- 16.4° Beaumé

This is a rather thick, brownish-black oil, with a sharp odor.

Distillation.

Sample of 150 c.c. distilled from copper in a current of gas. Distillation carried to a residue of dry coke.

First cut	40.8 per cent	32.1° Beaumé
Second cut	43.1 per cent	22.7°
Fixed carbon	16.1 grams per 100 c.c.	
	100.0 per cent	

On reduction of the second cut in a stream of gas, and calculation of the coke to asphalt, the oil shows the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	36.0 per cent
Fuel distillate	30.0°	15.4 per cent } Slop distillate
Reduced stock	10.5°	18.3 per cent } 22.7°—23.7%
Asphalt	"D"	40.3 per cent, or 141.4 lbs. per bbl.
		100.0 per cent

This oil decomposed very badly while first cut was running, and the proportion of stove oil is too large. The percentage of asphalt may have also been increased by this action.

The reduced stock from the heavy distillate was very thick, and of a rich color, but free from paraffin.

5417.*

Graham-Loftus Oil Company (Delaware-Union). Well No. 34.

Gravity ---------- 17.7° Beaumé

This is a moderately thick, brownish-black oil, of a strong but not sulfurous odor.

Distillation.

Sample of 150 c.c. distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	15.2 per cent	40.4° Beaumé
Second cut	14.9 per cent	30.2°
Third cut	60.9 per cent	21.9°
Fixed carbon	9.0 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	11.0 per cent (about)
Stove oil	33°	15.0 per cent
Fuel distillate	30.5°	20.6 per cent } Slop distillate
Reduced stock	14.1°	30.9 per cent } 21.9°—51.5%
Asphalt	"D"	22.5 per cent, or 79.0 lbs. per bbl.
		100.0 per cent

*Analysis by J. P. P.

The kerosene runs rather dark, but treats out well and is of satisfactory quality. The reduced stock is sweet and of good color, with moderate viscosity, and no paraffin.

6464.*

Birch Oil Company. Well No. 3.

Gravity ---------- 18.6° Beaumé

This is a moderately limpid, brownish-black oil, with a mild odor.

Distillation.

Sample of 300 c.c. distilled from copper, first three cuts dry, last cut in current of gas. Distilled to a residue of dry coke.

First cut	5.0 per cent	51.7° Beaumé
Second cut	15.3 per cent	40.2°
Third cut	11.5 per cent	30.8°
Fourth cut	59.2 per cent	21.6°
Fixed carbon	9.0 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	63° Beaumé	None
Engine distillate	52°	5.0 per cent
Kerosene	42°	14.0 per cent
Stove oil	33°	11.5 per cent
Fuel distillate	30.0°	23.5 per cent (Slop distillate
Reduced stock	14.4°	23.5 per cent 21.6°—47.0%)
Asphalt	"D"	22.5 per cent, or 79.0 lbs. per bbl.
		100.0 per cent

The light products from this oil ran yellow from the still, and only fairly sweet, but treated out with the test acid to water-white oils of the best odor. The reduced stock, of rather high viscosity, had a somewhat dark color with good green outertone. A little paraffin appeared in this stock.

7448.†

Petroleum Development Company. Well No. 26.

Gravity ---------- 19.0° Beaumé

Sulfur ---------- 1.09 per cent by weight

Distillation.

Sample of 200 c.c. distilled from a glass flask, without the use of steam or gas.

Below 392° F.	11.2 per cent	42.6° Beaumé
392 to 482°	10.5 per cent	33.7°
482 to 572°	15.5 per cent	28.2°
572° to grade—a	28.3 per cent	28.1°
572° to grade—b	9.9 per cent	25.5°
Asphalt	23.1 per cent	Grade "D" (about)
Water and loss	1.5 per cent	
	100.0 per cent	

*Analysis by J. P. P.

†Analysis by H. N. Cooper.

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	12.0 per cent
Stove oil	33°	9.7 per cent
Middlings and lubricants	27.4°	55.0 per cent
Asphalt	"D"	23.1 per cent
Loss	---	0.2 per cent
		100.0 per cent

7447.*

Columbia Oil Producing Company. A well.

Gravity ---------- 19.3° Beaumé
Viscosity at 60° F. ---------- 39.96 Redwood
Viscosity at 185° F. ---------- 2.16 Redwood

The number of the well from which this sample was taken is not stated.

Distillation.

Sample of 200 c.c distilled from a glass flask, without steam or gas.

Below 212° F.	1.9 per cent	69.9° Beaumé
212 to 302°	6.2 per cent	53.5°
302 to 392°	9.2 per cent	40.6°
392 to 482°	8.1 per cent	32.4°
482 to 572°	17.3 per cent	27.7°
572° to grade—a	27.4 per cent	25.3°
572° to grade—b	3.8 per cent	26.0°
Asphalt	25.8 per cent	Grade "D" (about)
Loss	0.3 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	4.5 per cent
Engine distillate	52°	2.0 per cent
Kerosene	42°	10.5 per cent
Stove oil	33°	8.5 per cent
Middlings and lubricants	25.4°	48.4 per cent
Asphalt	"D"	25.8 per cent
Loss	---	0.3 per cent
		100.0 per cent

5420.†

Columbia Oil Producing Company. Well No. 13.

Gravity ---------- 20.1° Beaumé

This is a moderately limpid oil, of a brownish-black color, and a mild odor.

Distillation.

Sample of 160 c.c. distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	6.1 per cent	52.3° Beaumé
Second cut	6.1 per cent	42.3°
Third cut	16.2 per cent	32.7°
Fourth cut	63.9 per cent	20.8°
Fixed carbon	7.7 grams per 100 c.c.	
	100.0 per cent	

*Analysis by H. N. Cooper.
†Analysis by J. P. P.

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	6.5 per cent
Kerosene	42°	6.0 per cent
Stove oil	33°	16.0 per cent
Fuel distillate	29.9°	19.8 per cent } Slop distillate
Reduced stock	15.1°	32.4 per cent } 20.8°—52.2%
Asphalt	"D"	19.3 per cent, or 67.1 lbs. per bbl.
		100.0 per cent

The light products from this oil treated out well, and were of good quality. The last cut gave a reduced stock of good color and high viscosity, but showing a good deal of paraffin.

4422.*

Petroleum Development Company. Well No. 23.

Gravity ---------- 20.3° Beaumé

This is a moderately limpid, brownish-black oil, with a mild odor.

Distillation.

Sample of 175 c.c. distilled from copper, first three cuts dry, last cut in a current of gas. Distillation carried to a residue of dry coke.

First cut	8.5 per cent	49.4° Beaumé
Second cut	7.3 per cent	39.5°
Third cut	10.8 per cent	33.1°
Fourth cut	65.3 per cent	22.3°
Fixed carbon	8.1 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of inert gas, and calculation of the carbon to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	6.02 per cent
Kerosene	42°	10.0 per cent
Stove oil	33°	11.0 per cent
Fuel distillate	30.0°	26.3 per cent } Slop distillate
Reduced stock	13.8°	26.4 per cent } 22.3°—52.7%
Asphalt	"D"	20.3 per cent, or 71.3 lbs. per bbl.
		100.0 per cent

The light products from this oil ran only fairly pale, but treated out to white and sweet oils. The lubricating stock was of fair quality.

*Analysis by J. P. P.

2427.*

Petroleum Development Company. Well No. 31.

Gravity ---------- 20.3° Beaumé

This is a moderately limpid oil, of a brownish-black color and a mild odor.

Distillation.

A sample of 100 c.c. distilled from glass to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight of asphalt corrected (factor x 0.8) for oxidation during evaporation. The original figures are as follows:

Below 302° F.	Trace	
302 to 518°	23.0 per cent	41.2° Beaumé
Residue above 518°	75.0 per cent	14.0°
Loss	2.0 per cent	
	100.0 per cent	

These figures are equivalent, after reduction of the residue to asphalt, to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	21.0 per cent
Stove oil and lubricants	---	53.3 per cent (not separated)
Asphalt	"D"	25.7 per cent, or 90.2 lbs. per bbl.
		100.0 per cent

2466.†

Fullerton Consolidated Oil Company (Industrial). Well No. 6.

Gravity ---------- 20.5° Beaumé

This is a rather limpid, dead-black oil, with a mild odor.

Distillation.

A sample of 125 c.c. distilled from glass to a temperature of 518° F. Residue from this distillation reduced to "D" asphalt in vacuum. Lubricating stock from this run reduced to 20.9° stock in vacuum. The results from the three distillations are:

Crude oil.

Below 302° F.	3.6 per cent	55.0° Beaumé
302 to 518°	19.6 per cent	39.3°
Residue above 518°	76.8 per cent	14.0°
	100.0 per cent	

Residue from above.

Lubricating stock	46.1 per cent	24.0° Beaumé
Asphalt	30.7 per cent	Grade "E"
	76.8 per cent	

Lubricating stock from above.

Fuel distillate	12.4 per cent	34.0° Beaumé
Reduced stock	33.7 per cent	20.9°
	46.1 per cent	

*Analysis by E. N. Moor.

†Analysis by Wayne Colver.

On bringing these figures together, they give the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	5.5 per cent
Kerosene	42°	12.0 per cent (about)
Fuel distillate	34.0°	18.1 per cent
Reduced stock	20.9 per cent	33.7 per cent
Asphalt	"E"	30.7 per cent, or 107.8 lbs. per bbl.
		100.0 per cent

It will be noted that the asphalt is softer than the usual test grade, the percentage being therefore too large for direct comparison with other runs.

4429.*

Brea Cañon Oil Company. No. 21.

Gravity ---------- 20.5° Beaumé

This is a moderately limpid oil, of a brownish-black color and rather sharp odor.

Distillation.

Sample of 200 c.c. distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	9.9 per cent	50.8° Beaumé
Second cut	7.5 per cent	40.9°
Third cut	13.8 per cent	33.2°
Fourth cut	58.2 per cent	22.0°
Fixed carbon	10.6 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the carbon to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	8.0 per cent
Kerosene	42°	9.5 per cent
Stove oil	33°	14.0 per cent
Fuel distillate	30.6°	15.5 per cent) Slop distillate
Reduced stock	16.6°	26.5 per cent (22.0°—42.0%
Asphalt	"D"	26.5 per cent, or 93.0 lbs. per bbl.
		100.0 per cent.

The light products from this oil came over pale and sweet, and took the test acid well. The last cut was of good color, mild odor and medium viscosity. This gave a reduced stock of rich color, but thick with paraffin.

*Analysis by J. P. P.

5418.*

Graham-Loftus Oil Company. Well No. 25.

Gravity ---------- 21.2° Beaumé

This is a moderately limpid oil, of a brownish-black color and mild odor.

Distillation.

Sample of 200 c.c. distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dryness.

First cut	12.8 per cent	51.6° Beaumé
Second cut	6.9 per cent	40.7°
Third cut	13.3 per cent	33.0°
Fourth cut	61.8 per cent	20.1°
Fixed carbon	5.2 grams per 100 c.c.	

100.0 per cent

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	12.0 per cent
Kerosene	42°	7.0 per cent
Stove oil	33°	14.0 per cent
Fuel distillate	29.4°	16.7 per cent / Slop distillate
Reduced stock	14.5°	37.3 per cent \ 20.1°—54.0%
Asphalt	"D"	13.0 per cent, or 45.6 lbs. per bbl.

100.0 per cent

The light products from this oil come from the still with good color, and take the test acid well. The last cut gives a reduced stock of rich color, and high viscosity, but with too much paraffin for ordinary use.

4421.*

Petroleum Development Company. Well No. 47.

Gravity ---------- 21.8° Beaumé

This is a moderately limpid, brownish-black oil, with a mild odor.

Distillation.

Sample of 225 c.c., distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	9.4 per cent	52.2° Beaumé
Second cut	10.3 per cent	41.3°
Third cut	12.9 per cent	33.1°
Fourth cut	57.4 per cent	27.5°
Fixed carbon	10.0 grams per 100 c.c.	

100.0 per cent

*Analysis by J. P. P.

On reduction of the last cut in a current of gas, and calculation of the carbon to asphalt in the usual manner, we have the following commercial analysis:

Gasoline	61° Baumé	None
Engine distillate	52°	9.5 per cent
Kerosene	42°	10.0 per cent
Stove oil	33°	13.0 per cent
Fuel distillate	29.7°	31.0 per cent / Slop distillate
Reduced stock	14.7°	11.5 per cent \ 27.5°—42.5%
Asphalt	"D"	25.0 per cent, or 87.8 lbs. per bbl.
		100.0 per cent

The light products from this oil ran fairly pale, and treated out to water-white and sweet oils. The lubricating end of the crude was of fair color, a little burned, and of low viscosity. The reduced stock was dark in color, of high viscosity, and showed some paraffin.

4423.*

Brea Cañon Oil Company. Well No. 1.

Gravity ..... 22.5° Baumé

This is a moderately limpid oil, of a brownish-black color and mild odor.

Distillation.

Sample of 200 c.c. distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	13.7 per cent	52.1° Baumé
Second cut	8.1 per cent	42.4°
Third cut	13.7 per cent	32.5°
Fourth cut	56.7 per cent	21.3°
Fixed carbon	7.8 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is had:

Gasoline	61° Baumé	None
Engine distillate	52°	14.0 per cent
Kerosene	42°	9.0 per cent
Stove oil	33°	12.0 per cent
Fuel distillate	29.6°	19.1 per cent / Slop distillate
Reduced stock	15.5°	26.4 per cent \ 21.3°—45.5%
Asphalt	"D"	19.5 per cent, or 68.4 lbs. per bbl.
		100.0 per cent

The light products from this oil ran dark in color, but took the test acid well, and came out water-white and sweet.

*Analysis by J. P. P.

4424.*

Union Oil Company. Sansinena No. 2.

Gravity ---------- 25.1° Beaumé

This is a moderately limpid oil of brownish-black color, and rather strong, sharp odor, not sulfurous.

Distillation.

Sample of 175 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	8.7 per cent	60.5° Beaumé
Second cut	8.3 per cent	49.8°
Third cut	4.9 per cent	41.4°
Fourth cut	17.2 per cent	32.5°
Fifth cut	52.2 per cent	20.5°
Fixed carbon	8.7 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	8.0 per cent
Engine distillate	52°	7.0 per cent
Kerosene	42°	7.0 per cent
Stove oil	33°	17.0 per cent
Fuel distillate	30.0°	14.1 per cent } Slop distillate
Reduced stock	14.6°	25.1 per cent } 20.5°—39.2%
Asphalt	"D"	21.8 per cent, or 76.5 lbs. per bbl.
		100.0 per cent

The light products from this oil ran pale, and treated out well with the test acid. The heavy stock was rather pale, sweet and of medium viscosity. The reduced stock was very dark, of medium viscosity and free from paraffin.

5419.*

Pico Oil Company. Well No. 2.

Gravity ---------- 27.5° Beaumé

This is a limpid, greenish-black oil, with a strong, fairly sweet and very gassy odor.

Distillation.

Sample of 100 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	11.7 per cent	61.0° Beaumé
Second cut	9.2 per cent	50.3°
Third cut	16.0 per cent	41.0°
Fourth cut	10.5 per cent	30.7°
Fifth cut	46.9 per cent	18.6°
Fixed carbon	5.7 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

The quantity of lubricating stock was too small to reduce. On calculation of the coke to asphalt we have the following commercial analysis:

Gasoline	61° Beaumé	11.7 per cent
Engine distillate	52°	6.0 per cent
Kerosene	42°	19.0 per cent
Stove oil	33°	7.5 per cent
Middlings and lubricants	18.6°	41.6 per cent (not separated)
Asphalt	"D"	14.2 per cent, or 49.8 lbs. per bbl.
		100.0 per cent

The light products ran pale from the still, and treated out readily to white, sweet oils of the best grade. The lubricating stock is of good color and rather high viscosity, and free from paraffin.

6460.*

Birch Oil Company. Well No. 5.

Gravity ---------- 27.9° Beaumé

This is a very limpid, brownish-green oil, translucent in thin layers, and having a mild and gassy, but not very sweet, odor.

Distillation.

Sample of 300 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	11.2 per cent	60.3° Beaumé
Second cut	5.6 per cent	51.4°
Third cut	16.3 per cent	42.1°
Fourth cut	10.4 per cent	34.0°
Fifth cut	51.1 per cent	21.8°
Fixed carbon	5.4 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last distillate in a current of gas, and calculation of the residue to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	10.5 per cent
Engine distillate	52°	6.3 per cent
Kerosene	42°	10.5 per cent
Stove oil	33°	10.0 per cent
Fuel distillate	30.0°	22.6 per cent } Slop distillate
Reduced stock	16.0°	26.6 per cent } 21.8°—49.2%
Asphalt	"D"	13.5 per cent, or 47.4 lbs. per bbl.
		100.0 per cent

The first runnings from this oil were of fair color, but had a peculiar and rather sour odor, which in the main, though not entirely, disappeared in the test treatment. The second and third fractions, however, though rather musty as they came from the still, treated out to water-white oils of the sweetest odor. The stove oil also took treatment well.

The lubricating stock was of good color, was slightly burned, and had a high viscosity, which was due to paraffin. The reduced stock was also

*Analysis by J. P. P.

of pale color, and contained enough paraffin to give it a pasty consistency at normal temperatures, making it valueless for lubricants.

5421.*

Fullerton Oil Company. Well No. 10.

Gravity ---------- 32.2° Beaumé

This is a very limpid, greenish-black oil, with a mild, gassy odor.

Distillation.

Sample of 180 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to residue of dry coke.

First cut	14.9 per cent	60.8° Beaumé
Second cut	11.5 per cent	51.9°
Third cut	22.5 per cent	41.9°
Fourth cut	9.8 per cent	32.7°
Fifth cut	37.4 per cent	22.1°
Fixed carbon	3.9 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	14.9 per cent
Engine distillate	52°	11.5 per cent
Kerosene	42°	22.5 per cent
Stove oil	33°	9.8 per cent
Fuel distillate	29.9°	13.9 per cent } Slop distillate
Reduced stock	15.8°	17.6 per cent } 22.1°—31.5%
Asphalt	"D"	9.8 per cent, or 34.4 lbs. per bbl.
		100.0 per cent

The light products from this crude run very pale and sweet, and take the test acid readily. The reduced stock from the heavy distillate is of good color and high viscosity, and shows only a trace of paraffin. This is a refining oil of the highest grade.

2465.†

Puente Oil Company. Columbia lease.

Gravity ---------- 32.4° Beaumé

This is a limpid, greenish-black oil, with a mild, gassy odor. The number of the well from which this sample was taken is not recorded.

Distillation.

A sample of 125 c.c. distilled from glass to a temperature of 518° F. Residue from this distillation reduced to "D" asphalt in vacuum. Lubricating stock from this run reduced to a 21° stock in vacuum. The results from the three distillations are:

Crude oil:

Below 212° F.	7.0 per cent	67.5° Be.	} 59.1° Beaumé
212 to 302°	15.5 per cent	50.3° "	
302 to 518°	26.6 per cent	41.5°	
Residue above 518°	50.9 per cent	16.3°	
	100.0 per cent		

*Analysis by J. P. P.

†Analysis by Wayne Colver.

Residue from above:		
Lubricating stock	40.7 per cent	24.7° Beaumé
Asphalt	10.2 per cent	Grade "D"
	50.9 per cent	
Lubricating stock from above:		
Fuel distillate	14.9 per cent	33.7° Beaumé
Reduced stock	25.8 per cent	21.0°
	40.7 per cent	

On bringing these figures together, they give the following commercial analysis:

Gasoline	61° Beaumé	20.0 per cent
Engine distillate	52°	None
Kerosene	42°	29.1 per cent
Fuel distillate	33.7°	14.9 per cent
Reduced stock	21.0°	25.8 per cent
Asphalt	"D"	10.2 per cent, or 35.8 lbs. per bbl.
		100.0 per cent

2438.*

Fullerton Oil Company. Well No. 2.

Gravity ——— 32.8° Beaumé
Flash point ——— below 60° F. (open test)

This is a very limpid, greenish-black oil, with a mild and gassy odor.

Distillation.

Sample of 100 c.c. distilled from glass to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are as follows:

Below 212° F.	5.5 per cent	59.6° Beaumé
212 to 302°	18.3 per cent	
302 to 518°	27.7 per cent	40.8°
Residue above 518°	47.9 per cent	11.0°
Loss	0.6 per cent	
	100.0 per cent	

After evaporation of the residue to asphalt, and calculation, we have the following commercial analysis:

Gasoline	61° Beaumé	20.0 per cent
Engine distillate	52°	None
Kerosene	42°	31.5 per cent
Stove oil and lubricants		34.8 per cent (not separated)
Asphalt	"D"	13.7 per cent, or 48.1 lbs. per bbl.
		100.0 per cent

*Analysis by E. N. Moor.

4420.*

Petroleum Development Company. Well No. 35.

Gravity ---------- 32.8° Beaumé

This is a very limpid, greenish-black oil, with a mild and gassy odor.

Distillation.

Sample of 180 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	12.5 per cent	60.9° Beaumé
Second cut	11.9 per cent	52.2°
Third cut	23.3 per cent	42.0°
Fourth cut	17.5 per cent	31.7°
Fifth cut	29.4 per cent	25.4°
Fixed carbon	5.4 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of inert gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	12.5 per cent	
Engine distillate	52°	12.0 per cent	
Kerosene	42°	23.0 per cent	
Stove oil	33°	15.0 per cent	
Fuel distillate	29.7°	18.0 per cent	Slop distillate
Reduced stock	---	6.0 per cent	25.4°—24.0%
Asphalt	"D"	13.5 per cent, or 47.4 lbs. per bbl.	
		100.0 per cent	

The light products from this crude ran pale, and treated out to water-white, sweet oils of the best quality. The heavy distillate gave a semi-solid reduced stock containing much paraffin. The value of this oil is entirely in the light end.

2441.†

Puente Oil Company. Columbia lease.

Gravity ---------- 33.0° Beaumé

Viscosity at 60° F. ---------- 2.82 Engler

This is a very limpid oil of a greenish-black color and a mild, gassy odor. The number of the well from which sample was taken is not recorded.

Distillation.

Sample of 100 c.c. distilled from glass to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and the weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are as follows:

Below 212° F.	5.8 per cent	60.9° Beaumé
212 to 302°	16.0 per cent	
302 to 518°	27.6 per cent	42.8°
Residue above 518°	50.0 per cent	15.5°
Loss	0.6 per cent	
	100.0 per cent	

*Analysis by J. P. P.

†Analysis by E. N. Moor.

After evaporation of the residue to asphalt, and calculation, we have the following commercial analysis:

Gasoline	61° Beaumé	23.8 per cent
Engine distillate	52°	None
Kerosene	42°	29.0 per cent
Stove oil and lubricants	---	34.7 per cent (not separated)
Asphalt	"D"	12.5 per cent, or 43.9 lbs. per bbl.
		100.0 per cent

2439.*

Puente Oil Company. Columbia lease.

Gravity ---------- 33.4° Beaumé

This is a very limpid oil of a greenish-black color, with a mild, gassy odor. The number of the well from which sample was taken is not recorded.

Distillation.

Sample of 100 c.c. distilled from a glass flask, to a temperature of 518° F. Residue reduced to asphalt by open evaporation, and weight corrected (factor × 0.8) for oxidation during evaporation. The original figures are as follows:

Below 212° F.	4.4 per cent	60.9° Beaumé
212 to 302°	17.7 per cent	
302 to 518°	30.8 per cent	41.3°
Residue above 518°	45.6 per cent	12.7°
Loss	1.5 per cent	
	100.0 per cent	

On reduction of the residue to asphalt, and calculation, we have the following commercial analysis:

Gasoline	61° Beaumé	22.0 per cent
Engine distillate	52°	None
Kerosene	42°	27.0 per cent
Stove oil and lubricants	---	44.6 per cent (not separated)
Asphalt	"D"	6.4 per cent, or 22.4 lbs. per bbl.
		100.0 per cent

7449.†

Petroleum Development Company. Well No. 39.

Gravity ---------- 34.0° Beaumé

Sulfur ---------- 0.41 per cent by weight

Distillation.

Sample of 200 c.c. distilled from a glass flask, without steam or gas.

Below 212 ° F.	12.9 per cent	63.4° Beaumé
212 to 302°	15.3 per cent	53.1°
302 to 392°	11.5 per cent	44.0°
392 to 482°	11.1 per cent	33.6°
482 to 572°	9.6 per cent	30.7°
572° to grade—a	19.5 per cent	26.3°
572° to grade—b	6.5 per cent	25.8°
Asphalt	11.0 per cent	Grade "D" (about)
Loss	2.6 per cent	
	100.0 per cent	

*Analysis by E. N. Moor.

†Analysis by H. N. Cooper.

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	17.5 per cent
Engine distillate	52°	10.5 per cent
Kerosene	42°	16.0 per cent
Stove oil	33°	16.0 per cent
Middlings and lubricants	26.1°	26.4 per cent
Asphalt	"D"	11.0 per cent
Loss	---	2.6 per cent
		100.0 per cent

4419.*

Petroleum Development Company. Well No. 39.

Gravity ---------- 34.3° Beaumé

This is the same oil as is shown by analyses 2467 and 7449. A comparison of these figures will show how much the results are influenced by even slight differences in the method of running. The figures below come closer than the others to representing the results which would be had in large scale refining.

First cut	23.7 per cent	60.5° Beaumé
Second cut	11.3 per cent	49.1°
Third cut	8.3 per cent	40.6°
Fourth cut	24.7 per cent	33.0°
Fifth cut	28.9 per cent	20.6°
Fixed carbon	3.1 grams per 100 c.c.	
	100.0 per cent	

On calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	22.0 per cent
Engine distillate	52°	8.0 per cent
Kerosene	42°	13.5 per cent
Stove oil	33°	24.5 per cent
Middlings and lubricants	20.6°	24.2 per cent
Asphalt	"D"	7.8 per cent, or 27.4 lbs. per bbl.
		100.0 per cent

The light products from this oil ran very pale and sweet, and treated well. The lubricating stock was not rerun—compare Nos. 7449 and 2467.

*Analysis by J. P. P.

2467.*

Petroleum Development Company. Well No. 39.

Gravity ..... 34.5 Beaumé

This is a very limpid, greenish-black oil, with a mild, gassy odor.

Distillations.

A sample of 150 c.c. distilled from glass to a temperature of 518° F. Residue from this distillation reduced to "D" asphalt in vacuum. Lubricating stock from this run reduced to a 23.0° stock in vacuum. The results from the three distillations are:

Crude oil:			
Below 212° F.	6.2 per cent	70.0° Be.	62.0° Beaumé
212 to 302°	17.1 per cent	60.2° "	
302 to 518°	28.6 per cent	43.0°	
Residue above 518°	48.1 per cent	17.0°	
	100.0 per cent		
Residue from above:			
Lubricating stock	33.7 per cent	26.5° Beaumé	
Asphalt	14.4 per cent	Grade "D"	
	48.1 per cent		
Lubricating stock from above:			
Fuel distillate	12.5 per cent	32.7° Beaumé	
Reduced stock	21.2 per cent	23.0°	
	33.7 per cent		

On bringing these figures together they give the following commercial analysis:

Gasoline	61° Beaumé	24.5 per cent
Engine distillate	52°	None
Kerosene	42°	27.4 per cent
Fuel distillate	32.7°	12.5 per cent
Reduced stock	23.0°	21.2 per cent
Asphalt	"D"	14.4 per cent, or 50.5 lbs. per bbl.
		100.0 per cent

*Analysis by Wayne Colver.

CHAPTER XVII.

SCATTERING WELLS IN LOS ANGELES, ORANGE, AND SAN BERNARDINO COUNTIES.

In these three counties a number of wells have been drilled at greater or less distance from any of the other producing fields. Because of the scattering nature of this work, it is difficult to treat it in connection with any of the other fields, and it is therefore brought together, regardless of location, in this chapter. In all, these wells have been located in seventeen distinct groups, of from one, to as high as fourteen wells, and are scattered all the way from the line of Ventura and Kern counties, on the west and north, to the Mojave desert and the south line of Orange County.

LOS ANGELES COUNTY.

LANCASTER.

The town of Lancaster is located on the Valley division of the Southern Pacific railroad, eight miles from the north line of the county. This is on the southern edge of the Mojave desert, which stretches north to the foot of the Tehachapi, and east into San Bernardino County. From the Tehachapi, on the north, and which consists entirely of granite and highly metamorphosed rocks, to the San Gabriel and San Bernardino ranges on the south, the desert is a flat plain, very little eroded, with a surface consisting, in the southern and western portions, of a light clay soil, very fertile where water can be had, and in the northern and eastern portions of loose granitic sand, dotted with dry alkali lakes. From this plain rise many isolated peaks and ridges, most of which are of volcanic origin, and at the east in particular evidences of extensive volcanic action are numerous and widespread. Aside from these volcanic buttes and ridges but little rock is to be seen, and late marine sediments are entirely wanting, except on the southwestern border of the basin, where the rocks of the San Gabriel consist in part of marine sandstones and shales. The indications are that this great basin has been the site of a large elevated lake at no distant period.

B. F. Carter wells. The two wells drilled at Lancaster were just north of the town, one on each side of the railroad, in sections 9 and 10, 7 N. 12 W., S.B.M. The first well was drilled in the year 1900, was 1400 feet deep, and is said to have had traces of oil. Well No. 2 was drilled in 1901, was 2000 feet deep, and was abandoned as pinched, casing reduced to 4 inches. The contractor who drilled these wells states positively that the second, at least, had a fair showing of oil, though nothing approaching a paying quantity.

In this connection two wells drilled at Mojave may be mentioned, though they are over the line, in Kern County.

Swastika Oil Syndicate. This company started a hole a short distance northeast of the town in 1910, and was still drilling late in the following year. This well is said to have reached a considerable depth, but what depth is not certainly known.

Mojave water well. A well somewhere about 1800 feet deep is said to have been drilled close to the town, several years ago. This well was designed to supply the town with water, but at this depth developed very little water, and no indications of oil or gas.

CALABASAS.

In the Santa Monica range, near the west line of Los Angeles County, two wells have been drilled. This range has already been noted as lying north of the Salt Lake field. From this point it reaches to the west almost the entire width of Ventura County, paralleling the ocean. The rocks of these hills are described as mainly clays, shales and sandstones, similar in every respect to the formations found in the Simi and Santa Clara Valley region to the north. No direct evidences of petroleum in the way of seepages or brea deposits have been noted.

Ramera Oil Company. This well is located on section 6, 1–17, five miles southwest of Calabasas post office, and eight miles from Canoga, on the Chatsworth branch of the Southern Pacific. It was drilled in the years 1910 to 1912, and went to a depth of 2137 feet. It is said to have had a good deal of gas, and was once reported to have had a streak of shale showing thick black oil, though there are doubts as to whether this stratum was really bituminous. It finally struck hot, flowing sulfur water, and was suspended.

Calabasas Oil Company. This hole is not exactly located, but is said to be a short distance north of the Ramera well, and near the summit of the ridge. In March, 1912, it was reported as drilling, at 667 feet.

REDONDO.

One well was drilled at Manhattan Beach, and at least three south of the town of Redondo. These are in formation very similar to that of the San Pedro hills, as described under the next subhead.

Hedley & Fullerton; Manhattan. This well is located on the B. B. Hiss place, on Twenty-second street, Manhattan Beach, about one half mile east of the railroad. It was drilled in 1910 to a depth of 540 feet, and abandoned with a bit in the hole.

Bixby Ranch well. This hole is located on Rancho Los Palos Verdes, about two miles south of the town of Redondo, and nearly as far from the coast. It was drilled in 1910, to a depth in excess of 2600 feet. No discovery was reported to this depth, but the final results are not known.

Volcano Oil Company. The two wells of this company were located about two miles south of Redondo, but close to the coast, No. 2 being about one half mile the farther south. Well No. 1 was drilled in 1900, and abandoned at 1100 feet with a bit in the hole. Well No. 2, drilled in the succeeding year, was carried to a depth of 1285 feet, and abandoned because of excessive water. Neither of these holes gave any indications of oil.

SAN PEDRO.

The peninsula on which the town of San Pedro is situated consists of a single range of hills, rising abruptly from the ocean, and almost as steeply on the land side, and ranging nearly east and west. The highest point in these hills is Mt. San Pedro, with an elevation of 1482 feet, while the summit of the ridge lies generally at about 1000 feet elevation.

A description of the superficial geology of these hills is given by W. L. Watts in Bulletin 19 of the State Mining Bureau. From this description it appears that the body of these hills is composed of hard whitish or yellowish shales, shown in section along the coast line, and overlain on the land side by a tough clay formation. At Point Fermin, and also on Dead Man's Island, to the east, are exposures of a soft yellowish sandstone. All of these rocks, shales, clays and sandstones are bituminous in places, or traversed by bituminous streaks.

In the mass of the hills are bodies of eruptive rocks, which give but small exposures, and have not been placed relative to the other formations. They appear, however, to have been injected at a rather late period, and probably occur as dykes. The entire structure of the range appears to be very much broken and disturbed. No live seepages have been noted in these hills, the occurrences of bitumen being in the form of thin asphaltic stringers in the shale, and a dry bituminization of the sandstones.

Five wells are known to have been drilled in the endeavor to locate a possible oil deposit, in addition to the three wells at the west end of the range noted under the head Redondo. As will be seen from the list below, none of these wells tested the country to any great depth, though such results as were had were not of an encouraging nature.

San Pedro Oil Company. This well was drilled in 1895, at the foot of the hill just west of the town. This well showed: adobe soil to 100 feet, dark-colored shale and brea to 400 feet, light-colored shale to 550 feet, brown shale to 850 feet. The water in this well was shut off near the surface, and it is said that small quantities of heavy oil were found. Abandoned at 850 feet because of lost tools.

Pierson Hotel well. This well was drilled many years ago, by parties now unknown, near the old Pierson Hotel. Watts reports: "This well is said to be 495 feet deep, nearly all clay, or clay shale, with a little brea, and with a stratum of asphaltum near the bottom of the hole."

New San Pedro Oil Company. This well was on the north face of the hills, a short distance west of the town. It was drilled in 1901, and was carried to something over 800 feet, where it was abandoned for financial reasons. The owners of this well report that it found much water and a showing of gas, but no oil.

Dodson well. The so-called Dodson well was a short distance southeast of the foregoing, and in about the same position as regards the hill formation. It was drilled in 1901, and abandoned at about 900 feet, finding a good deal of sulfur water, and a little gas.

Lighthouse Oil Company. The location of this well was due south of the town of San Pedro, on the point close to Point Fermin lighthouse. This well was drilled in 1901, and abandoned at something over 800 feet, for financial reasons. It is said to have shown nothing in the way of indications except a little of the dry bitumen which is in evidence on the surface at this point.

LONG BEACH.

Two wells drilled for water in the city of Long Beach gave indications of oil, though these were never followed up.

The well drilled at the asbestos plant struck gas at a depth of 350 feet, and is reported to furnish enough gas to run the plant. No oil was found in this well.

A water-well drilled at one of the laundries, to a depth of 375 feet, also found a little gas, which bubbles up through the water. There is enough heavy oil in this well to spoil the water for the use of the plant, and it is said that after standing for some time, clean oil may be dipped from the surface of the water as it stands in the casing.

NORTH OF LOS ANGELES.

At least four wells, and probably several others of which no certain records remain, were drilled a short distance north of the bounds of the Los Angeles City map. The two western wells were on the north side of the so-called Los Angeles anticline, the two toward the east were in a strip of formation similar to that of the Los Angeles field, extending to the northward into and over the older formations of the San Gabriel range. With these may be included ten holes whose locations are shown on the map, north of the fault-line bounding the City field. The results from these wells indicate that the strata north of the fault are oil-bearing at many places, but no production has ever been had, while a great deal of water was found in all the holes drilled. This territory as a whole appears to be considerably disturbed.

Angelina Heights well. Described as located in Lot 26, Block 19, of Angelina Heights addition. Reported to have passed through a six-foot sand at 960 feet, carrying considerable oil, but was abandoned at 1186 feet because of quicksand and water. Drilled about 1895.

Bryant & Company. Described as having been located at Ivanhoe, and probably on the northwest quarter, northeast quarter, section 7, 1 N. 13 W. This well was more than 1000 feet deep, and penetrated mainly soft sandstone and sandy shale, with calcareous hard shells. Small quantities of oil and much water were found.

Chance well. Near the corner of Echo Park road and Belmont avenue, Los Angeles City. Drilled about 1895, and abandoned at 450 feet because of water and running sand. Said to have had a showing of oil near the bottom.

Climax Oil Company. This well is not exactly located, but is said to have been on the Verdugo road, one and one half miles north of Garvanza, which would be in the east end of Eagle Rock Valley. It was drilled in 1901, and was abandoned at a little over 700 feet, with the tools in the hole. Much water was found, but no indications of oil.

Eureka Oil Company. This well was on the line of Effie street, about four hundred feet north of Berkeley avenue. It is said that this hole was abandoned at about 700 feet because of water, having had a showing of oil.

Fudicker well. South of the corner of First and Reno streets, Los Angeles City. This location is just north of the fault line, or possibly in broken material. It was drilled about 1895 to a depth of 550 feet, through sandstone and shale. The sandstone showed a little oil, but the well struck flowing water, which issued from the well for a long time, carrying a little oil.

Gasson & Co. This well is not located, but is said to have been on the Hunter tract, west of Garvanza. Drilled about 1895 to a depth of 985 feet, and abandoned because of water. No oil was found.

Lookout Mountain well. This well was located just north of Reservoir street a short distance west of the line of Figueroa street, Los Angeles City. This location is a short distance north of the fault-line. This well is reported to have been drilled to 550 feet, and abandoned because of water, with a small showing of oil.

McIntosh well. Located at the corner of Bellevue avenue and Old Temple road, Los Angeles City, just north of the fault-line. This well was carried to a depth of 1004 feet, and finally abandoned on account of water, which was met at intervals from the top of the hole to the bottom. Oil was found at 80 feet, 165 feet, 406 feet, 432 feet and 520 feet, at which depth the oil rose three hundred feet in the hole, and baled 20 barrels in one afternoon. Below this nothing but water was found to 996 feet, when another small showing of oil was had. The formation was soft sandstone and clay shale.

Okell & Barber. The location of this well is a short distance southeast of the foregoing. It was abandoned at 300 feet because of water, and had showings of oil in shale at 90 feet and 110 feet.

Oregon Oil Company. This well was farthest to the west of the string of wells along the north side of the break, being at Vermont avenue and Barrow street. It is said to have been abandoned at 209 feet, with some water, but no oil.

Polhemus well. This hole is a short distance northwest of the Okell & Barber well. It was drilled at a very early day, probably as early as 1865. It is said to be 390 feet deep, and yielded water and a little oil.

Sisters' Hospital wells. Just north of the Sisters' Hospital grounds, where there are several producing wells, are two water wells, said to be 800 feet deep, without any showing of oil. These wells are evidently back of a very sharp break, as the producing wells just south get their oil at a less depth.

Union Oil Company. A well was drilled by this company at First and Alvarado streets, just north of the line of production. This well was carried to 900 feet, and abandoned on account of water. It is reported that an oil-yielding sand was found about fifty feet down, but below this nothing but water, indicating that this hole was immediately on the upper edge of the producing formation.

Wilmot & Holden. This well is on the Long place, on Prospect avenue, about one half mile east of Vermont. Reported to be 500 feet deep, and to have struck flowing water carrying a little oil at 175 feet.

Thompson Bros. Located on Morton street, between Geneva and Mecca avenues. Depth, 625 feet, with a thin stratum of oil sand, and much water.

SOUTH OF LOS ANGELES.

At least seven wells have been drilled south of the central City field, and a number south of the West field, but of the latter no records whatever can be found, except of two wells, though it is believed that there were a number. The list so far as known is as follows:

Maier & Zobelein. Two wells were drilled on the property of the Maier & Zobelein Brewing Company, between Commercial, Aliso, Vignes and Amelia streets. The first hole was about 1100 feet deep, the second 1600 feet. Considerable bituminous shale was encountered down to the 700-foot level, and flowing water at 825 feet, then shale to 1266 feet, and below this sand and gravel, with much water. Neither well showed any oil, and both were abandoned.

United States Hotel well. On the property of the United States hotel, on Main street, opposite the post office, a deep water-well was drilled in

the year 1883. This hole was 900 feet deep, and found water with a good deal of inflammable gas in blue shale.

McIntosh well No. 2. This well is at the corner of State and Mignonette streets. It was carried to 1025 feet, mostly in sandy clay, with salt water, but no oil.

Allison & Barlow. This well was drilled near the corner of Second street and Beaudry avenue. Depth said to be about 1000 feet, abandoned on account of water. No oil.

Dunkelberger well. At the corner of Second and Emerald streets. About 800 feet deep, with a very little oil, but much water.

Johnson well. This well was drilled near the corner of Third and Figueroa streets, and at a depth of 1100 feet had water only.

Perkins well. Located near Third and Jewell streets. Was drilled to a depth of 600 feet, and had salt water only.

COMPTON.

Between Howard Summit on the San Pedro line, and Compton on the line to Long Beach, seven shallow wells have been put down. These wells were not drilled for oil, but as they were in untested territory, and gave some indications of bitumen, they are of interest.

Three wells were drilled at an early date on the C. E. Rosecrans tract, in sections 18 and 19, 3–13. Two of these wells were 135 feet and 90 feet deep, the depth of the third is not recorded. The deeper well gave sufficient gas to be used for fuel purposes, for many years, the shallower only a small amount.

About one and one half miles southeast of these wells, on Duncan property, in the Hayward tract, a 400-foot water well shows quite a lot of gas. It is said that there is a deposit of brea in the vicinity of this well, which has been collected and used for fuel.

In a 330-foot well, half a mile west of the Rosecrans wells, shale carrying oil was found at a depth of 180 feet, and a black carbonaceous streak at 197 feet.

In 1900 an oil well was reported to be drilling in section 19, a short distance southeast of the gas wells. It had then reached a depth of 420 feet, and the drillers claimed to have a showing of oil, but the later history of the well is not now discoverable.

There is also said to be a showing of oil on the water from a 380-foot irrigation well in section 23, southeast of the Rosecrans wells.

Even these slender indications are of interest in connection with the fact that these wells are located along a little ridge, perhaps 100 feet in height, a continuation of the Tijera hills. This low roll is the only interruption to the continuity of the plain between Los Angeles and the ocean, and has the same position relative to the Santa Monicas as have

the Coyotes to the Puente hills. Where the summit of this raise is cut through by the Long Beach electric line, an anticlinal structure is plainly shown, and it seems strange that (at least so far as could be learned) no prospecting has ever been done along this ridge. It seems quite certain that, if any oil is to be found between Los Angeles and the ocean, a point along the ridge between Palms and Compton would be the most favorable place at which to drill.

RAPETTO HILLS.

The Rapetto hills are a continuation to the eastward of the ridge in which the Los Angeles oil deposits occur, and connect this range with the Puente hills, in which the Whittier and Fullerton fields are found. The formations are of similar age and structure to those of the Puente hills, though in the Rapettos the anticlinal form seems to be more perfect and less disturbed by faulting. Nevertheless, though some deep drilling has been done, no indications of oil have been found.

Puente Oil Company. The Rapetto well of this company was located on the southeast quarter of the northeast quarter of section 29, 1 S. 12 W. This well was drilled in 1910, and was abandoned at 2600 feet without the slightest indications of oil.

Standard Oil Company. This company's No. 1 well was located on the northeast quarter, northwest quarter, section 34, 1–12, while No. 2 was on the southwest quarter, northeast quarter, 28, 1–12, both on land of the Monterey Park Land Company. These wells were drilled in 1910, and are said to have each been very close to 3300 feet deep. They were abandoned when drilled, and appear to have been completely dry.

Arctic Oil Company. The three wells of this company on land of R. Garvey are on the east half, northeast quarter, section 34, 1–12. These wells were drilled in 1897 and 1898, and were dry holes at 600 feet, 1200 feet and 1100 feet, respectively.

Dollar Oil Company. This well is located on the northwest quarter, southwest quarter, section 32, 1–12. At last reports it was drilling at intervals, and had reached a depth of some 2000 feet. Traces of oil were claimed at about 1000 feet, but an examination of the dump did not substantiate this, and the hole is believed to have been barren.

Belle Vernon Oil Company. This well is located just one mile south of the above, and is on the flat at the foot of the hill, while the Dollar well is on gently sloping ground, and the Puente, Standard and Arctic wells are near the summit of the ridge. This well was started early in 1911, and at the end of that year was said to be nearly 3000 feet deep, and was drilling at intervals. The results from this well are not known.

As these wells were located in such manner as to cross-cut the formation, they seem to dispose of any possibility of finding oil in this portion of the range.

Whiting, Dwight. A well owned by D. Whiting *et al.* was drilling in June, 1900, at the intersection of the San Gabriel branch of the Southern Pacific, and the El Monte wagon road. This is in the northwest quarter, southeast quarter, section 19, 1–12. At this time the well was reported to be 500 feet, drilling, and to have passed a thin oil sand at about 300 feet, but the final depth is not known.

Okell Core Drill Company. Started a well on the northeast quarter, southwest quarter, section 18, 1–12, in the year 1911. Results not known.

CHINO VALLEY.

But little drilling has been done in the Chino Valley, and this not for oil, though in one well a small amount of oil was found and is still in evidence.

Schuyler Ranch well. On the Schuyler ranch, section 16, 1 S. 1 E., a 300-foot well drilled for water is reported to have a small amount of oil.

Sickleworth Ranch well. This well was located in section 5, 2–10, a short distance north of the town of Puente. This well was carried to a depth of 800 feet, and found much water, but no oil.

Two wells are said to have been drilled near the town of Azusa, but no further information could be had.

At the foot of the Puente range, southeast of the town of Puente, a shallow hole has lately been drilled, in which a good showing of light oil was struck. Details are not known, but it is said that the hole gave enough oil to bale, and that this was materially lighter than the oil from the Puente wells.

ORANGE COUNTY.

OLIVE.

A single well is known to have been drilled about four miles east and a little south of the town of Olive, eight miles southeast of the Anaheim wells of the Amalgamated Oil Company.

Orange County Oil Company. The well of this company was on the southwest quarter of section 13, 4–9. It was drilled in the year 1900, to a depth of 700 feet, and is said to have shown traces of oil. This well is in the bed of Santiago Creek, a short distance above the point where it emerges from the hills. This creek for some distance follows the foot of a fault scarp, the north being the upthrust side. The rocks here are mainly sandstone with a little shale, and near the mouth of the creek a capping of what appears to be volcanic ash is found. Farther up the creek, and on the north side, are workable deposits of a soft and rather lignitic coal, but no direct indications of oil are reported from any point in these hills.

SANTA ANA.

East and southeast of the town of Santa Ana are two shallow holes drilled for oil, both of which are dry.

Wm. Manser wells. Drilled in the year 1894, on lots 284 and 383 of the San Joaquin ranch. These wells are 484 feet and 719 feet deep, and were drilled through gravel, sand and clay, but found no oil.

NEWPORT BAY.

Eleven wells have been drilled in the immediate vicinity of Newport Bay, a town and harbor eighteen miles southeast of Long Beach. The town is situated on flat land, elevated but little above high tide line. Back of this flat land, which is about one mile wide, and parallel to the beach, is a bluff perhaps one hundred feet in height, above which is a flat mesa stretching away for a long distance to the north. This bluff is said to show slight seepages of oil, though these could not be found. The wells are situated on this mesa, from one eighth mile to two miles from its edge, and the depths at which the various wells reached the sand indicate that it pitches back very rapidly from the ocean. Whether this bluff, which follows the ocean for some distance, is due to faulting or to wave action is not apparent on the surface, but the character of the oil, and the behavior of the wells close to the edge, indicate that it may be due to a fault.

Balboa Oil Company. This well is the farthest from the ocean of any of this group, being on the east side of the Southern Pacific Company's Santa Ana–Newport line, about three miles from the beach. It was drilled in the year 1909, and carried to 2974 feet. Much gas was found, and what appeared to be a large amount of oil, but there was much water in the hole, and the oil was so heavy and viscous that it was found impossible to pump it. The well was suspended for a long time, and is believed to be abandoned.

Newport Bay Oil Company. This company drilled three wells a short distance southeast of the Balboa well, in a straight line directed southeast. Well No. 1 was drilled in 1906, and was 2640 feet deep. This well had an encouraging amount of oil, but the casing collapsed and the hole was abandoned. Well No. 2 was about three hundred feet southeast of No. 1, and was drilled in 1908. Though this hole was carried much deeper, to 3442 feet, it had only traces of oil, and as the hole at that depth was not in condition to carry farther it was abandoned.

Well No. 3 was about the same distance southeast of No. 2, and was drilled in 1910. This hole was 2809 feet deep, and entered a stratum of very heavy tar, from which more or less fluid was pumped. The oil, however, was so heavy that it could not be pumped without steaming, and after working over the well a long time, the property was abandoned and the corporation dissolved.

A comparison of the results on these three wells indicates very strongly that this oil was not found in a stratum of sand, as in the fields farther inland, but in broken formation similar to that of the Santa Barbara coast. Both the character of the oil and its occurrence correspond exactly with those of the tar wells at Naples and Carpinteria.

Kellerman Oil Company. The well of this company was one location southwest of Newport Bay No. 3, and almost due south of No. 2. This well was drilled in 1910, to a depth of 2995 feet. Near the bottom of the hole a tar streak similar to that encountered in Newport Bay No. 3 was entered, and the well was put on the pump. This oil was so heavy that when not heated by direct sun, it could be rolled into a ball, and pumping was almost an impossibility, the small amount taken from the well being worried out a little at a time. In addition to this, the upper water could never be shut off, and finally the well was pulled and abandoned.

Clyde Jackson Oil Company. This well was on the west side of the railroad, almost due west of the Newport Bay wells. It was drilled in 1910, and in the latter part of that year was 2800 feet deep, and was being cemented for the third or fourth time. This well was then said to have some oil, but was so thoroughly flooded as to prevent a test. Its later history is not known.

Tidewater Oil Company. This company started to drill in the year 1911, a short distance southwest of the Kellerman well. The results of this operation are not known.

Newport Oil Company, or Port Orange Asphalt Company. A company operating under one of these names drilled three wells not far from the edge of the bluff, about the year 1900.

Well No. 1 was 775 feet deep, and found a tar similar to that of the Kellerman well between 180 feet and 300 feet. Well No. 2 was a short distance northwest of No. 1. It was 765 feet deep, and found the same streak at 300 feet. Well No. 3 was southeast of No. 1. It was 885 feet deep, and was a dry hole, said not to have had any traces of the material found in the other two wells. Nos. 1 and 2 were pumped for a short time, but the small yield did not justify operating expense, and they were abandoned.

Santa Ana Oil Company. This company drilled a well at the edge of the bluff, about one mile east of the Newport wells, in the year 1889. This well was 1235 feet deep, and found much water, but no indications of oil. It was abandoned because of lost tools. This company also operated at Piru, Ventura County, and at two points in the Newhall field.

LAGUNA BEACH.

Laguna Beach Oil Company. This company drilled a well at Abalone point, on lot 164 of the San Joaquin ranch, about one mile northwest of Laguna Beach. This well was drilled in 1899, and was 680 feet deep. At this depth the casing was accidentally shot off, and the hole lost. No indications of oil were found.

SAN JUAN CAPISTRANO.

The territory between Newport Bay and the Orange County line is described in some detail by W. L. Watts, Bulletin 19 of the State Mining Bureau. That portion of the coast line in the neighborhood of San Juan Capistrano is characterized by thick beds of a yellowish sandstone, lying nearly flat, and cut into cliffs by wave action. No seepages or other superficial indications of petroleum have been noted in this neighborhood. Two shallow wells have been drilled in this vicinity.

Egan Ranch wells. The wells are located on Rancho Niguel, about one mile north of the town of San Juan Capistrano, in section 36, 7–8. The first well, 315 feet deep, is said to have shown gas and some oil in black shale near the bottom. The other well was 253 feet deep, and barren.

SAN BERNARDINO COUNTY.

CHINO.

The Puente hills extend to the eastward from the Fullerton field, and cross the southern point of San Bernardino County. The lithologic character of these hills on their eastern face is the same as in that portion on which the Fullerton wells are located, and as there are bituminous deposits at a number of points, many wells have been drilled in the hope of finding an eastern extension of this field. To this time, however, such efforts have not met with success, the only oil found being too heavy and in too small quantity to be of value. The records of this work are as follows:

Towns well. This well is situated at the foot of the Puente hills, on the east face, on the northeast quarter of section 17, 2–8, about two miles southwest of the town of Chino. This well was drilled in 1900, and abandoned at a depth of 1000 feet. Flowing sulfur water was struck at 750 feet, but no indications of oil were found.

Gird well No. 1. This well was located on the east face of the Puente range, at an elevation of about 1000 feet, on the southwest quarter of section 18, 2–8. About one half mile southwest of this location is a large deposit of bituminous sand. This well was drilled about 1895, to a depth of some 800 feet. It is reported that this well passed through two sands yielding oil, but that these were cased off and the well carried down as a water well.

Chino Valley Beet Sugar Company. Well No. 1 of this company was drilled on the Los Angeles County side, and is mentioned under the heading Fullerton. Well No. 2 was located on the east face of the range, at the 1200-foot level, on the southwest quarter of section 30, 2–8. This well was drilled in 1898, to a depth of 1000 feet. It penetrated shales of various colors, and streaks of sand, finding a rather dry oil sand between 440 and 465 feet, which gave a seepage of oil near the bottom. Water was struck below this, and the well was abandoned.

Fullerton Sunset Oil Company. This company drilled a well on the flat land near the foot of the hills, in the neighborhood of Chino Creek, northeast quarter of section 36, 2–8. This well was drilling in the year 1901, but nothing is known as to its history.

Union Oil Company; Chino. The Chino well of the Union Oil Company was located on the northwest quarter, section 34, 2–8, just at the foot of the eastern face of the Puente range. This well is said to have been some 3000 feet deep, and was abandoned when finished, but nothing can be learned as to what was found.

Cords well. This old well was located on the northwest quarter, section 32, 2–8, just north of the Chino Land and Water Company's wells. Nothing is known as to its history.

Chino Land and Water Company. The first three wells of this company were located along the south line of section 32, 2–8, near the summit of the ridge. These wells were drilled about the year 1901, and were from 900 to 1000 feet deep. These wells all made a little oil, and were pumped for a time, but the oil was heavy and in small quantity, and they were finally abandoned as unprofitable.

This company also drilled a well on the northeast corner of section 24, 2–8, on the flat southeast of the town of Chino. The depth of this well is not known. A stratum of heavy tar was struck, and this is said to be still flowing slowly from the abandoned hole.

Globe Oil Company. This company drilled three wells south of the Chino Land and Water Company's wells, two being in the northeast quarter, section 5, and one in the northeast quarter, section 6, 3–8. These wells are said to be in the neighborhood of 1000 feet deep, and to have found a little heavy oil, but no profitable production. They are abandoned.

Gird well No. 2. This well was located near the summit of the ridge, but rather on its southeast face, on the northeast quarter, section 7, 3–8. This well was carried to a depth of 1200 feet, and penetrated shales and sands, with much water. This water was brackish, and carried a small amount of oil.

CHAPTER XVIII.

SANTA BARBARA COUNTY.

The oil deposits of Santa Barbara county do not fall strictly within the scope of the present report, as the San Rafael mountains, the direct westerly extension of the Tehachapis, terminate near the city of Ventura. But for purposes of convenience the Santa Maria or Cuyama river has been arbitrarily taken as a northerly boundary, thus including the entire area of Santa Barbara County (which properly belongs to the Coast country) with southern California.

The counties of Santa Barbara and Ventura are the only portions of the State whose main topographic lines have a consistent east and west direction. In all other parts of the State, though varying somewhat with strictly local conditions, the higher mountain ranges and the principal streams bear north-northwest by south-southeast, or parallel to the main coast line, while the general trend of minor streams and cañons is northeast and southwest. But, as a glance at the map of the State will show, the coast line, which as far south as Point Arguello has the usual southerly trend, here bends at almost a right angle, and from Point Concepcion follows a course nearly due east to Punta Gorda, on the eastern boundary of Santa Barbara County, thence southeast to Dume Point, just east of Ventura county, thence due east to Santa Monica, where the southerly direction is resumed, and continues to the southern boundary of the State.

As stated in a previous chapter, the northern portion of Ventura County consists of a shapeless mass of mountains, the focus of a number of radiating ranges. To the east, across Los Angeles and San Bernardino counties, extends a single range known variously as the Sierra Madre, San Gabriel and San Bernardino mountains. To the northeast, the Tehachapi rears a high barrier between the Mojave desert and the San Joaquin Valley, swinging to join the Sierra Nevada at the southwest corner of Inyo County. To the northwest the Coast Range mountains lie in two parallel ranges, the eastern, or Mount Diablo mountains, forming the western boundary of Kern County, leaving between this range and the Santa Margaritas to the west a high tableland known as the Cuyama Valley and Carissa plain; while to the west from this mountain focus extends the Santa Ynez range, parallel to the San Rafael mountains and to the southern coast of Santa Barbara County, and terminating but a short distance from Point Arguello.

Santa Barbara County thus consists of an area of rectangular shape, bounded on the east by a clustering mass of high mountains, on the north by the valley and cañon of Santa Maria River, on the south by the ocean, with a narrow strip of coast land backed by the Santa Ynez

mountains, and on the west by the ocean, and a low and irregular range of hills parallel thereto. The nonmountainous portion of the county consists of the valley of the Santa Maria River, in the northwestern portion of the county; of a region of barren sand hills along the western coast; of the Santa Ynez Valley, lying between the mountains of that name and the low hills south of Santa Maria Valley, and of the narrow strip of coast land.

Santa Maria, Santa Barbara and Los Alamos valleys, and portions of the coastal strip, are intensively cultivated. The lower hills are devoted to grazing, but the higher mountains are in the main rocky, rough, and quite sterile, being almost waterless, though there is a belt of pine timber toward the west. The climate over the whole of this county is warm, equable and pleasant, with a moderate but sufficient rainfall occurring entirely during the winter months. The whole area is one of great scenic beauty, and the coast strip in particular is famed as a winter resort.

Petroleum has been found or diligently sought in several portions of Santa Barbara County, as follows:

Much prospecting has been done in the northern portion of the Casmalia range of low hills parallel to the western coast. At only one point, near the railroad station of this name, has profitable oil been found. These developments will be described under the heading Casmalia.

Between the Santa Ynez and Santa Maria valleys there are two ranges of hills, of moderate height, between which lies the narrow valley of Los Alamos Creek. On the western portion of the range to the north of this valley, and between it and Santa Maria Valley, lies the "Santa Maria" or Old Field, covering both the north and south sides of the hills. This is the only case so far noted in this State where oil is found on both sides of a single hill range. This field is a large producer of light oil.

East of the Old Field, but lying on the north slope only, is the "Cat Cañon" or "East Side" field, an important source of heavy oil production, though yet but partially developed.

On the south side of the hills which divide Los Alamos from Santa Ynez Valley lies a group of wells known as the Lompoc or Purissima group, and described under the former name. These wells produce oil of medium gravity.

In the upper reaches of the Santa Ynez Valley oil has been sought at a number of points, though so far without success. These developments are described under the heading "Santa Ynez."

Between Gaviota and Santa Barbara, along the southern coast of the county, persistent search for oil has been made, confined entirely to the immediate vicinity of the shore line, where a number of heavy oil seep-

ages are found. Oil in small quantities has been found in several wells, but no profitable production. These developments are described under the heading Naples to Santa Barbara.

Within the limits of the little town of Summerland, a very small pool of heavy oil was opened some years since, intensively developed, but now nearly exhausted. This group of wells is described under the subheading "Summerland."

East and west of Summerland, between Santa Barbara and the mouth of Rincon Creek, are a number of oil seepages and a deposit of bituminous rock. Several wells have been drilled near these seepages, but no production has been had. These wells are described under the head Santa Barbara to Rincon.

In the foothills of the Santa Ynez range, back of the coast strip just mentioned, is a line of older outcrops, which show some seepages. Several wells have been drilled here, and one lease produced some oil for a time, but is not now being worked. These developments are described under the heading Santa Ynez Foothills.

Prospecting has been carried some distance up Rincon Creek, and some work is yet under way. These wells are almost immediately on the line between Santa Barbara and Ventura counties, and two or three of them are on the Ventura side. These wells are to be found under the heading Rincon Creek.

Wells in the Casmalia Group.

Twelve wells have been drilled in the Casmalia hills, lying parallel to the west coast of the county. Two of these wells are considered as producers, two or three others found a little heavy tar, but the others, though quite deep, made no discovery whatever, and the territory along the coast is generally considered as nonproductive, except for the small pool in the immediate vicinity of Casmalia. The records, as far as they were obtainable, are as follows:

Casmalia Ranch Oil and Development Company. The first two wells of this company were on the Rancho Casmalia, near the east line, and about one mile from Casmalia station. This location probably falls on section 23, 9–35.

Well No. 1 was drilled in 1901, and was 980 feet deep. It was abandoned because of the loss of a string of tools, buried in caving formation, and made no discovery.

Well No. 2 was carried to a depth of 1700 feet, and into a stratum of liquid asphalt. This rose in the casing, and great efforts were made to get production from the hole, but the tar proved too heavy to handle, and the hole was finally abandoned.

Well No. 3 was located on the opposite side of the railroad, close to Schumann siding. It was abandoned at a slight depth for financial reasons.

Casmalia Petroleum Company. This company has a producing well on the Rancho Punta de la Laguna, a short distance west of the railroad, and about one mile north of Casmalia station. This well makes an oil of about 11° Beaumé, and appears to be capable of considerable production, so far as the capacity of the sands is concerned. To this time, the difficulty of handling this very viscous material and getting it out of the hole has prevented either a large or a steady production. The oil is desired for asphalt making, for which it is very suitable.

Kern Trading and Oil Company; Casmalia. This well, known locally as the Southern Pacific well, is close to the railroad line, on the west side. and one mile north of Casmalia station. It was drilled in the year 1905 to a depth of 2690 feet, and is considered a producer. The oil, which is extremely heavy, is said to have been encountered at some 1600 feet depth, but the hole was carried down in the hope of finding a light oil sand at greater depth. It is said that indications of a rather light oil were had at the bottom of the hole, but the heavy oil from above was never cased out, and finally the pipe was pulled back to the shallow sand, and the well put on the pump. As with the Casmalia well, the extreme viscosity of the oil has prevented any large production, and the well is pumped only at intervals.

Elizalde Oil Company. The well of this company was located in the hills west of the railroad, between Schumann and Waldorf sidings, but can not be exactly located. It was drilled in the year 1901, to a depth of about 1000 feet, and is said to have found traces of oil, though the report is not authenticated.

Laguna Land Company. This company drilled two shallow holes on land of the Union Beet Sugar Company, near Betteravia. Both these wells stopped in the shifting sand, and were of slight depth. No discovery was made.

Mulholland Oil Company. The Mulholland well was located on lot 125 of Rancho Guadalupe, west of the railroad, and directly back of Waldorf siding. This well was drilled in the year 1904, and was abandoned at 1700 feet, without finding any indications of oil.

Syndicate Petroleum Company. This well was located about two miles northwest of Schumann siding, in the northeast quarter of section 10, 9–35. It was carried to a depth of approximately 3300 feet, and developed much water, but no oil, and was abandoned. This company also drilled in the southern part of the Fullerton field.

The Oil Company. A company with this extraordinary name drilled a hole somewhere near the Syndicate well, but not exactly located. This was abandoned at 3400 feet, without finding any oil.

Traders' Union Oil Company. The well of this company was drilled in the year 1904, just west of the railroad, and one and one half miles

north of Schumann siding. It was abandoned at a depth of about 3350 feet, with much water, but no oil.

Wells in the Santa Ynez Group.

Under this heading are grouped a number of wells scattered over the territory south of the Lompoc and Cat Cañon wells, and falling mainly within the bounds of Santa Ynez Valley or the adjacent hills. With but one exception (a well close to the Cat Cañon field) none of these wells have developed any oil, and prospecting has ceased, for the present at least, over the entire area.

Unfortunately, the information available as to many of these wells is very scanty, and of a number not even the depths can be learned. It may be useful, however, to give a list of the wells drilled, and such data as are at hand regarding them:

Dome Oil Company; Wickenden. The Dome well on the Wickenden tract is located on the east side of Cañada Arena, about two miles north of Los Alamos Creek. This well was drilled in the year 1911 to a depth approximating 2900 feet, and entered a body of very heavy and viscous tar, about the weight of water, and solid enough to roll into balls in the hand. There appears to be a large supply of this material, but up to this time it has been found impracticable to raise any large quantity to the surface.

Associated Oil Company; Pezzoni. The well drilled by the Recruit Oil Company on the Pezzoni tract (now belonging to the Associated Oil Company) is located on the west side of Cañada Arena, close to the south line of Rancho Tinaquaic, and about one and one half miles north of the Dome well. This hole was drilled in the year 1904, and carried to a depth of 2200 feet. It is said to have had traces of oil at 1250 feet, but nothing below, and to have stopped in crystalline rock (diabase?).

Princess Oil Company; Muscio. The well of the Princess on the Muscio tract is on the west side of Cuaslui Creek, about one half mile south of the southern line of Rancho Tinaquaic. This well is drilling, and is reported (May, 1912) to be 3425 feet deep, and to have had several showings of oil, mostly in shale.

Oil Fields Syndicate. The well of this company is on the John Bell tract, some four miles west of the Dome and Pezzoni wells, but can not be exactly located. It is drilling, and is reported (May, 1912) to have considerable oil at 2650 feet.

Primavera Oil Company. This company, a San Francisco corporation, drilled four wells on the Underhill tract, in the year 1901. These wells appear to have been on lots 14 and 13 of the F. T. Underhill ranch, a portion of Rancho Laguna. Nos. 1 and 2 were a short distance east of the ranch house, and about one half mile from Los Alamos Creek,

while No. 4 was about one mile to the northeast, and No. 3 can not be located. Nos. 1 and 2 were lost holes at about 500 feet and 800 feet, respectively. No. 3 was abandoned because of lost tools at 750 feet, and No. 4 struck boulders and much fresh water at about 500 feet. No indications were found at this slight depth.

Jalama Oil and Development Company. This company is said to have drilled a rather shallow hole on the Diblee ranch, in the cañon of Jalama Creek, near the junction of Cañada la Escondido, and in the southwest corner of Rancho San Julian. This hole was drilled in 1902, and found no oil. The depth is not known.

Bear Creek Oil and Mining Company. The well of this company was located on the south side of Bear Creek, on the Rancho Lompoc, and some two miles from the ocean. This well was drilled in 1907, and carried to a depth of 3500 feet. It found a little tar, as is usual in wells along this coast, but no oil, and was abandoned.

The Bear Creek company later developed a producing property in North Midway, Kern County.

Las Cruces Oil Company. This hole was located in the west branch of Gaviota Creek, on the east line of Rancho San Julian, and four miles (in a straight line) north of the ocean. It was drilled in 1909 and 1910, to a depth not known, but in excess of 2900 feet, and is said to have been entirely barren. Abandoned.

Micaela Oil Company. The Micaela well is also reported to have been abandoned, but nothing is known as to its history. This well was located in the northwest quarter of section 26, 6–32.

San Lucas Oil Company. This well was located on the south bank of the Santa Ynez River, four miles east of the town of Santa Ynez, in section 14, 6–30. It was drilled in 1910 to a depth of 3460 feet, and in spite of many reports to the contrary, showed no indications whatever of oil, being from top to bottom in a light-brown shale. Abandoned.

Santa Ynez Oil Company. The two wells drilled by this company in the year 1900 can not be located, though they were probably in the neighborhood of the town of Santa Ynez. Well No. 1 is said to have been about 1000 feet deep, with much water, but no oil, while No. 2 was abandoned at about 1400 feet, also without indications.

Santa Barbara-California Oil Company. No information whatever can be had regarding the three wells of this company. Nos. 1 and 2 were located near the north line of Rancho San Carlos de Jonata, probably in sections 20 or 21, 7–31. Well No. 3 was about four miles to the south, in section 9, 6–31. Two of these wells are said to have been quite deep, and all three to have been entirely barren.

Buell Ranch Oil Company. The well of this company, later absorbed

five miles in length (from east to west). At the west end a definite limit has been set, only a short distance beyond present production, by the drilling of three deep failures. The wells farthest to the south are all producers, and while details as to these wells are lacking, it does not appear that any certain limit has been set in this direction. At the east end the field has lately been extended by the drilling of two moderate producers a mile to the east of former developments, and prospecting is still being carried in this direction. On the north limb two deep failures have been drilled, while in the northeastern portion of the developed area, which falls nearly on the anticlinal apex, two or three wells have found considerable oil, but have no production, leaving the final value in this direction open to doubt.

As in all fields where the developments are largely owned by a single corporation, information as to these wells was had with great difficulty, and the notes given below are much less complete than could be desired. Further, this group has not been visited by representatives of the Mining Bureau since the early part of 1911, and the following notes may be considered as of that date. Owing to the deliberation with which developments take place in this territory, however, it is not probable that any important changes have taken place since that time, other than as mentioned at certain points.

Union Oil Company; Burton. The Burton well of the Union Oil Company was located near the eastern end of Rancho Jesus Maria, in the southwest quarter of the southeast quarter of section 30, 8–34. This well was drilled in 1905, and carried to a depth slightly in excess of 4500 feet. It passed through a solid body of shale the entire distance, finding much water but no oil. It was pulled and abandoned. This well is farthest to the west of any in the Lompoc group proper.

Union Oil Company; Nichols. This well is located on the southeast quarter of section 29, 8–34, at the northwest extremity of the group. It was carried to a depth of about 3500 feet, and is said to have found a little oil, but nothing to make a producer, and was abandoned.

Sudden Oil Company. This well was on the northwest quarter of the northwest quarter, section 28, 8–34, a short distance to the northeast of the Nichols well. It was suspended at 1700 feet for financial reasons, without any indications of oil, and was finally pulled and abandoned.

Todos Santos Oil Company. About one mile east of the Sudden well, on the northeast forty of the same section, though over the line of the Rancho Todos Santos, the Todos Santos Oil Company drilled a deep hole in 1905. This well was carried to about 4300 feet, and is said to have been in an unbroken body of blue shale. No indications of oil were found, and the well was abandoned.

Barca Oil Company. This company started a well near the south-

eastern corner of the Rancho Todos Santos, but abandoned it at some 300 feet, for financial reasons.

Pacific Oil Fields, Limited. The wells of this company are on the southwest quarter of section 28, and on the west half of fractional section 33, 8–34. Here there are seven wells, of which No. 2 is a shallow water well, and No. 7 was drilling at last reports, though probably now completed. The depths of these wells, in order, but excepting Nos. 2 and 7, are as follows: 2705 feet, 2828 feet, 2800 feet, 2700 feet, and 2700 feet.

These wells pump on the beam, and produce an oil containing a large amount (up to 40 per cent) of firmly emulsified water. This is handled by the Cottrell electric process, and the oil brought down to a uniform content of 1 per cent moisture.

Orcutt Oil Company. The first well of this company was located on the northeast quarter of the northwest quarter, section 34, 8–34, and was drilled in 1909. It was abandoned at some 2900 feet, and is said to have been a practically dry hole at this depth.

The later wells are all on the southwest quarter, southeast quarter of section 28, 8–34. Here there were three wells producing and one drilling, when last visited, the depths of these wells said to range around 2,600 feet.

Union Oil Company—Eefson. The tract on which the Eefson wells are located includes an irregular shaped piece in the northwest corner of Rancho Mission de la Purissima, and the east half of fractional section 33, 8–34. Here there are seven wells, numbered Eefson No. 1 to No. 7, of which all but No. 3 are producers. There is also an abandoned hole some distance to the west of the other wells, about which nothing could be learned, except that it appears to be much older than the numbered wells.

Well No. 3 was abandoned at a slight depth, a lost hole. The depth of the producers is said to range from 2600 feet to 2800 feet, though this may be considered a very rough approximation.

Union Oil Company; Purissima. These wells, originally known as the Wise & Denigan wells, stretch in a double or triple line across the greater part of the width of the Rancho Purissima, near the northern line. Here there are fourteen wells, of which all are producers except No. 12. The depth of these wells is said to vary from 2600 feet to 2800 feet, those to the south being the deeper.

Both the Purissima and the Eefson wells make a very wet oil, which is strongly emulsified. This oil is handled by "topping" or "skimming" the water and a small amount of naphtha being removed by distillation at a low temperature, leaving a residue of fuel oil. In spite of the low gravity of these crudes (usually around 16° Beaumé), they contain up

to 4 or 5 per cent of bodies lighter than kerosene, this making them much more adaptable to a distillation process than less volatile crudes.

Union Oil Company—Hill. The Hill wells of the Union Oil Company are located in the northeast corner of Rancho Purissima. Here there are five wells, of which either three or four are somewhat productive.

Well No. 1 was drilled by Fox & O'Boy, of Lompoc, to a depth of about 2500 feet, and was a fair producer.

Well No. 2 was known locally as "Big Moses." It was drilled to a depth of 3850 feet, and looked like a very large producer, having, it is said, almost 1100 feet of clean producing sand. This well was drowned out by upper water, and was not producing when last visited. Well No. 3 was drilled to a depth of 3300 feet or over, and abandoned as a dry hole, having only traces of heavy tar. Nothing is known as to Nos. 4 and 5, though they appear to be making some oil.

Graciosa Oil Company. In addition to a number of wells in the Old Field, this company has two wells near the southern end of the Harris tract, No. 18 being some three fourths mile north of the south line, and one fourth mile from the east line, while No. 20 is near the southwest corner of the tract.

No. 18 is reported as a deep hole, and abandoned, though no details are known. No. 20 was still drilling in January, 1912, the depth at that time being approximately 3600 feet.

Los Alamos Oil and Development Company—Esperanza Consolidated Oil Company. The two wells started by the Los Alamos Oil and Development Company, but now owned by the Esperanza Consolidated Oil Company, are on the south line of Rancho Lompoc, and close to the northwest corner of section 5, 7–33. Well No. 2 is on almost the highest point of the ridge, and is visible from a long distance, either north or south.

Well No. 1 was drilled in 1904, and reached a depth of 2150 feet. It had a great deal of casing trouble, and was finally abandoned as pointed.

Well No. 2 was started shortly thereafter, and has been worked on at intervals ever since. This well was carried to a depth in excess of 4400 feet, and started off as a flowing well of large capacity. Because of lack of tankage it was shut down for some time, and when again opened failed to flow, a phenomenon which has been noted in the case of several wells in this county, and which has never been entirely explained. In working with the well a 600-foot string of four-inch pipe was lost, and when last reported the well was pumping some 40 barrels daily of a 34° greenish-brown oil, from the 3700-foot level.

Federal Oil Company—Esperanza Consolidated Oil Company. The well started by the Federal Oil Company has also passed into the hands

of the latter company. This hole is located on the south line of Rancho Lompoc, in the northwest corner of the northeast quarter of section 4, 7–33. In November, 1910, it was drilling at a depth of some 3000 feet.

Union Oil Company—Haslam. The Union Oil Company's Haslam well was located on the northwest quarter of section 5, 7–33. This well was carried to a depth of some 2600 feet, and is said to have had encouraging traces of oil, but got into trouble with both tools and casing, and was abandoned.

Dome Oil Company—Gem Oil Company. The Bullock lease of the Gem Oil Company, a triangular piece in the western part of fractional sections 6 and 7, 7–33, is now owned and operated by the Dome Oil Company, which also operates in the Old Field, Cat Cañon and elsewhere.

The first well on this property was drilled by the Gem Company, and was finished in 1910. This was a rather small producer of an oil of 16° Beaumé, at a depth of 2735 feet. Since that time Well No. 2 has been finished, also a producer, and No. 3 is now drilling (May, 1912).

Lompoc Oil Developing Company. The first three wells of this company were on the northwest quarter of section 8, 7–33, and near the north line of the section. Well No. 4 is over a mile to the east, on the northeast forty acres of section 9, 7–33.

Well No. 1 was drilled in the year 1902, and at a depth of 1000 feet was wrecked by a slight local earthquake, and abandoned.

Well No. 2 was carried to a depth of 1200 feet, in the succeeding year, but was abandoned because of the loss of a string of tools.

Well No. 3, now known as No. 1, was finished in the year 1905, at a depth of 3883 feet. It is stated to have had 519 feet of clean productive sand, and appeared to be a good well. The water from above, however, had never been properly shut off, and after a short period of operation the well was drowned, and for a long time stood idle, though cased and rigged. When last visited, preparations were being made to resume the attempt to shut out water.

Well No. 4 had reached a depth of 4070 feet when last visited, and had passed a strong seepage at some 3600 feet.

Purissima Hills Oil Company. The two wells of this company are on the west half of the west half of section 15, 7–33, No. 1 being about one fourth mile north of No. 2.

Well No. 1 was drilled in 1910, and was carried to a depth of about 3800 feet. This well was plugged and abandoned, and is said to have been entirely barren. Well No. 2 was drilling at last reports.

Anglo-Californian Oil Syndicate. The wells of this company are far to the west of the main Lompoc group, being about three miles east of

the ocean, and two miles north of the Santa Ynez River, on Rancho Jesus Maria. The wells are on the northern face of a small detached ridge which parallels the river, and the range in which the Lompoc wells are situated. At last reports both of these wells were drilling, No. 1 being then 3535 feet, and No. 2 about 2100 feet deep.

Drilling Conditions and Production. This completes the list of developments in the Purissima territory. It will be noted that from the center of the group westward there are but two or three lost holes, and it is quite certain that operation here is reasonably simple, wells being drilled with a standard rig through a fairly consistent shale and sand formation, with no more than the normal amount of water.

At the east end conditions are more difficult. There is much water, holes are very deep, and the ground does not stand up so well, so that several holes have been lost through mechanical troubles. This condition has hindered the proving out of the territory, and in spite of excellent showings of light oil in several wells, and a very fair steady production from the Dome's heavy oil wells, the value of this end of the field is still to be demonstrated.

While the strip is apparently nowhere very wide, it appears to be unbroken from the Pacific wells at the west up to the east end of the Purissima group, but farther east there is considerable local disturbance of the formation, and the Hill wells do not nearly average up with the wells farther west.

The production figures for the Lompoc wells have never been separated from those of Santa Maria, and it is therefore difficult to determine what the average output of these wells has been at any time. Estimates on the production of these wells during the year 1911 range from 505,000 to 795,000 barrels, which, allowing thirty-four producers, would indicate from 40 barrels to 64 barrels per well per day. In the writer's opinion, the former figure is nearer the truth, but in either case the average output is very much below the estimates made on these wells when they were new. It is highly probable that the advent of water into the oil sands (this did not make its appearance until some time after the first work was done), depreciated the production considerably, and allowance must also be made for the fact that these wells are now from four to six years old, in the main, but even with these allowances it would appear that the original estimates of several hundred barrels daily per well were based rather on production before the head had been pumped off than on settled output. But on the other hand, this output is had from comparatively shallow holes, under reasonably easy operating conditions, and even at the lower daily figure, should compare favorably in net results with those of most of the better known fields.

7405.*

Union Oil Company. Hill No. 1.

Gravity ---------- 16.2° Beaumé
Viscosity at 185° F. ---------- 8.23 Redwood
Flash point ---------- 70° F. (Abel-Pensky test)
Sulfur ---------- 4.43 per cent by weight (doubtful)
Thermal value ---------- 18,464 British thermal units

Distillation.

Sample of 200 c.c. distilled from glass, without the use of steam or gas.

Below 212° F.	1.3 per cent	
212 to 302°	3.9 per cent	51.0° Beaumé
302 to 392°	5.5 per cent	47.1°
392 to 482°	7.7 per cent	38.3°
482 to 572°	18.3 per cent	32.5°
572° to grade	34.3 per cent	25.7°
Asphalt	20.6 per cent	Grade "D" (about)
Water (7.0) and loss (1.4)	8.4 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	1.4 per cent (about)
Engine distillate	52°	3.2 per cent
Kerosene	42°	15.4 per cent
Stove oil	33°	18.3 per cent
Middlings and lubricants	25.7°	38.1 per cent
Asphalt	"D"	22.1 per cent
Loss	---	1.5 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

CHAPTER XIX.

SANTA MARIA, OR "OLD FIELD."

The Santa Maria field, while limited in area, has been one of the most profitable to its operators of any in the State, and the impetus given to prospecting by the successful operations here have been an important factor in the development of the local oil industry.

Topography.

This field covers the western end and both faces of a ridge rising to a height of some 1300 feet above sea level and emerging into the Santa Maria Valley at about the 600-foot level. The northern face of this ridge overlooks the Santa Maria Valley and the ocean, the western end faces the Casmalia hills, across a narrow valley draining to the north, while the southern face, less regular in form, drains to the little valley of the Los Alamos. This ridge is composed superficially of shale, with some sandstone, and many streaks of white, yellow and fiery-red diatomaceous shale, and as it is carved into shallow but rough cañons, and covered with a light growth of scrub oak, the claim that it is the most picturesque oil field in the State is probably justified.

The northern face of the ridge dips steeply to the valley, and almost every well on this face is visible to an observer at any point in the flat land. On the southern side the descent is much more gradual, and here the cañons widen into little flat valleys in which the wells are hidden.

The length of the developed territory, from Hartnell No. 5 on the west, to Newlove No. 23 on the east, is close to three and one quarter miles. Drilling has been carried some distance east and west beyond these limits, but without results in the way of production. The distance from the Hall wells on the north to Western Union No. 38 on the south, is about two and three-fourths miles. Within these narrow limits almost every portion has been found productive. Development still continues to the south, but in no other direction is there any apparent prospect for extension in the near future.

Most of the wells in this field are at some little elevation above sea-level, and small pipe lines to the railroads and to tidewater operate by gravitation, the viscosity of the oil being very low. Pipe lines of the Standard Oil Company, Union Oil Company of California, and Associated Oil Company carry oil, the first two to Port Harford, the latter to Gaviota. The only direct rail connection is by the Pacific Coast railroad, a narrow-gauge line connecting with the Pacific Coast Steamship Company's vessels, and running from Los Olivos, at the upper end of Los Alamos Valley, to Port Harford by way of Santa Maria and San Luis Obispo, thus circling the southern and western extremities of

Northeast from Folsom Lease, Santa Maria. Hartnell on Extreme Left. Brookshire and Radium in Left Distance. Pinal Camp and Wells in Center and Right. Folsom in Right Distance.

Radium, Brookshire and Pinal Leases. From Folsom Lease, Santa Maria. Town of Orcutt in Center Distance.

the field. The coast division line of the Southern Pacific is distant in a straight line but four and one-half miles from the nearest wells, but the nearest station accessible by road is Casmalia, at a distance of eight miles. The Santa Maria Valley railroad leaves the Southern Pacific at Betteravia, and passes through the town of Santa Maria to the Cat Cañon, but does not touch the Old Field.

There are three refineries close to the field and using local oil, being that of the Union Oil Company at Port Harford, of the Pinal Dome Refining Company at Betteravia, and a small plant of the Western Union Oil Company, located on the lease and making products for home consumption. The Associated Oil Company has a plant of some size at Gaviota, distant about thirty miles by pipe line. The extensive plant of the California Petroleum Refineries, Ltd., located at Oilport, is not at present in operation.

Santa Maria, distant about seven miles from the field, is an active little city of some 3500 population, and furnishes a large part of the supplies used in the field, other than casing and tools. Excellent stores of operating materials and tools of all kinds are maintained at Orcutt, distant a little over a mile from the nearest wells. Here there are also well-equipped shops for handling large machine work and forging. A number of the larger companies also maintain shops capable of doing all their smaller work, and in general the repair and supply facilities of the field are unusually good.

Geology and Drilling Conditions. The geology of this field is so thoroughly covered by reports of the U. S. Geological Survey (see Bulletins 317 and 322) that but a word as to operating conditions need be said.

The depth at which the oil lies in this field varies from 2000 to 4000 feet, but most of the wells draw from at, or near, the 3000-foot level. The upper layers are in general a brownish shale, somewhat sandy, with occasional thin, hard shells, and in some streaks scattered lumps of iron pyrites. These formations are practically dry, and stand up well, so that in spite of the considerable depths reached, wells are not unusually expensive, a well of say 3000 feet requiring from six months to a year in drilling, and costing from ten to twenty thousand dollars, fully equipped.

Some of these wells produce from a compact sand, but these are the exception. The oil in most of the wells is found in a shale hardly distinguishable in appearance (after removal of the oil) from the barren layers, and being of such density as to entirely preclude the possibility of the oil being drawn from the pores of the shale itself. It therefore follows, and this view is borne out by the appearance of the shale near the surface, that this oil is crevice oil, and is produced from joint

cracks in the shale. It follows again, that these wells produce almost no sand, and that the production from such wells as have, apparently, found extensive cracks in the shale, has been very large. The initial production of some of the wells in this field has been very great, and some remarkable vagaries in the behavior of adjacent wells has been noted, which could hardly be explained in any other manner. Some of these instances will be noted in connection with the operations of individual companies.

During the first five years of its existence this field produced a very dry oil, but since this time water has intruded itself into the oil measures to the serious detriment of the operations of some companies. The source of this water has not been determined with certainty in all cases, in spite of much argument and considerable experiment. In some instances conditions have been materially improved by cementing off water, and by plugging certain abandoned and wrecked holes; in others, such treatment has been a failure. Nevertheless it is probably true that the water now found in the oil sands or shales of this field is leakage water, and this is another instance of the old truth that too much care can not be exercised in the early operations in any field, no matter how dry in appearance, if this disaster is to be long avoided.

Much gas is met in most of the wells in the Old Field, and in the earlier years the pressure was quite high, though never what is found in the eastern gas fields, nor in the outer wells in the San Joaquin Valley. This gas is very rich in condensible elements, so much so that during the colder months of the year, quantities of gasoline and distillate collect in the pipes and traps through which the gas is carried. Three compression plants for separating gasoline from this gas are now building or in operation, but the industry is yet too new to judge as to its financial possibilities. All the fuel required in the field is still supplied from the wells, and the towns of Orcutt, Santa Maria and Guadalupe are furnished light and heat, but the amount of gas passing to waste, once very large, is now much reduced, and apparently the excess over fuel requirements will soon be exhausted.

The water supplies in the field are strongly alkaline and highly corrosive to boilers. No sweet water can be had by drilling, and for domestic purposes only condensed water is used. Fairly sweet water is found close to the surface at Santa Maria and Betteravia.

No definite dividing line can be placed between the Old Field and Cat Cañon, for while a considerable distance intervenes between the nearest producers, drilling has been carried across this space. For the purposes of this report, therefore, a line is arbitrarily drawn down the center of sections 15 and 16, 9–33, this line corresponding with the eastern boundary of the Las Flores tract. The southern limit taken covers all the northerly wells of the Graciosa and Western Union companies, the

later wells along the south line of these tracts being considered as belonging to the Lompoc group. On account of the close grouping of the operators in this field a geographical arrangement is unnecessary, and the various companies will therefore be named in alphabetical order.

Brookshire Oil Company. This company operates a tract of very irregular shape in sections 13, 14 and 29, 9–34, the wells, however, with the exception of No. 1, which is a water well, being on the south forty acres in section 23. On this tract it has nine wells, of which one is a shallow water well, two are pumping, three have some oil but are not pumping, one is flowing, one is being deepened, and one is abandoned. The records of these wells are of interest because of the unusual variations in the value of closely adjacent wells, and are therefore given in full.

Well No. 1, drilled in 1903, struck water at about 500 feet, and was finished at 748 feet. Since that time it has supplied a fair portion of the western end of the field with boiler water.

Well No. 2, and all later wells, are located on the northwest quarter of the southeast quarter of section 23. This well is 3054 feet deep, and is said to have had an initial production of 228 barrels per day. It is reported to have made a great deal of water, but is still on the pumping list.

Well No. 3 was drilled in 1904 to a depth of 3265 feet. This well also produced considerable water, and when last visited was being cemented at the bottom.

Well No. 4 is a fair producer at a depth of 2842 feet, and was drilled in 1095. This is said to have been a dry well, so far as water is concerned, but was never a heavy producer.

Well No. 5 was drilled in the same year, and is 2795 feet deep. In connection with the depths of these wells, it should be said that the surface elevation differs so little as to be negligible. No. 5, though somewhat shallower than No. 4, and located between this well and No. 7, which was a dry hole at a much greater depth, was a very large and steady flowing well, producing some five thousand barrels per day of light oil for many months, and is even yet a very substantial producer.

Well No. 6 was drilled in 1906 to a depth of 2920 feet, and is said to to have been a very small producer. It was not being operated when last visited.

Well No. 7 was drilled in 1909 to a depth of 4130 feet, and abandoned. This well is said to have been an absolutely dry hole, which, if true, is remarkable, this well being situated between No. 5 and No. 8, the former a flowing well, while the latter, if not a large producer, at least had some oil.

Well No. 8 was drilled in 1909 to a depth of 3772 feet, and made a small producer. When last seen it was being deepened.

Well No. 9, which is in almost the exact center of the forty and of the group of wells, was drilled in 1909 to a depth of 3746 feet. It is reported that this well was only a small producer, and it was being deepened when last visited.

The larger portion of the output of oil from this lease still comes from No. 5 well. The gravity of the oil ranges from 22° to 25° Beaumé. This company is also operating territory in the North Midway district, where they have production.

Central Union Oil Company. This company drilled a shallow hole on the southwest quarter of section 13, 9–34, during the earlier years of the development of this field. The hole is said to have been abandoned at a depth of 350 feet, in shifting sand.

California Coast Oil Company; Drumm. In the year 1904 this company drilled a shallow hole on the Drumm tract, the southeast quarter of section 13, 9–34. This well was abandoned in running sand, after striking water at about 1000 feet, as at that date means for handling the quicksands found in this portion of the field had not yet been invented.

The same company afterward drilled eight wells on the southern portion of the Hartnell tract, which will be found under the heading Union Oil Company—California Coast.

Coblentz Oil Company. The first hole of this company was drilled in the year 1905, on the northeast quarter of the northeast quarter of section 19, 9–33. This well was pointed at 2300 feet, and abandoned. The second well is a short distance to the southwest of No. 1, and at last reports was drilling at 3100 feet.

Dome Oil Company. This company has twelve wells, all producing, on the northeast quarter of the southeast quarter of section 29, 9–34, and on a strip following the north line of the Newlove Ranch to the south line of the same section.

The depths of these wells ranges from 2482 to 2900 feet. All are on the beam, but nothing is known as to the behavior of individual wells. A single well, No. 12, has lately been deepened to something over 3100 feet, finding a new sand about 150 feet below any stratum previously known. It is said that the production of this well was greatly increased, and that the lower sand gave a lighter oil, some 30° Beaumé.

Treasure Realty Company—Hall & Hall Oil Company. The northwest forty acres of section 19, 9–33, formerly operated by the Hall & Hall Oil Company of Santa Maria, is now held by the Treasure Realty Company of Los Angeles. On this tract there are three producing wells, all of which were drilled about the year 1905.

Well No. 1 is 2615 feet deep, No. 2 is 2910 feet, and No. 3 is 3225 feet deep. The larger part of the very small production comes from Well

Dome, Hobbs (Union) and Rice Ranch Leases, Santa Maria Oil Field.

Hills South of Zaca Valley, Santa Barbara County. Associated Oil Company's Zaca Pumping Station (Santa Maria-Gaviot line) on Right.

No. 3. It is said that the production of this lease was formerly much larger than at present, and that the gravity of the oil is also considerably depreciated, being now in the neighborhood of 22° Beaumé, whereas it was almost 26° when the wells were new.

The product of these wells is handled through a small refinery on the lease, which makes gasoline and fuel oil for local consumption. The wells also make considerable gas, and in the early part of the current year a compressor plant was being installed to remove the condensible gasoline from this gas, and that of a neighboring lease.

Laguna Oil Company. The well of this company is on the southwest forty acres of section 18, 9–33, and was drilled in the year 1909 to a depth of 3800 feet. This well was entirely barren, and was abandoned when finished.

Meridian Oil Company. This well is on the same forty-acre tract, but somewhat to the west of the Laguna well. It was abandoned at 700 feet as a spoiled hole, in the year 1904.

Lucerne Oil Company. The abandoned well of this company is located on the northwest quarter of the northwest quarter, section 19, 9–33. It was drilled in 1909 to a depth of 3938 feet, and was a dry hole.

New Pennsylvania Petroleum Company; Wiley. The single hole on this tract was drilled in the year 1905, and was abandoned at about 300 feet, because of shifting sand.

New Pennsylvania Petroleum Company; Kaiser. This tract includes portions of three forties along the north line of the Newlove Ranch, in section 19, 9–33. On this tract there are six wells, all producing. No. 1 is a small producer at 3310 feet, as it went into bottom water, and a portion of the producing sand was cased off. Nos. 2 to 5 range in depth from 2700 feet to 3250 feet, and are average pumping wells. No. 6 is the farthest well to the east, and started off, some five years ago, as a 1000-barrel flowing well. In January, 1912, this well was still flowing steadily, and had never made less than 300 barrels per day, the decline having been quite even over this long period. This well made no sand, and less water than most of the wells in the immediate vicinity, and considering its location at the extreme edge of the field, has been a phenomenal producer. This is evidently a crevice well, of which there were several instances in this field.

Pinal Oil Company. This company owns a large tract of very irregular shape, in sections 23 and 24, 9–34. Scattered over the southern portion of this tract are twenty-seven producing wells, and one (No. 18), which has been suspended for a long time, but never abandoned, having met mechanical troubles which there are hopes of correcting. Well No. 16 was deepened in 1909 to something over 4000 feet, but apparently the hopes of finding productive lower sands in this portion of the field

were not realized, as none of the other wells have been so treated. With this exception, the depth of these wells ranges from a minimum of 2477 feet to a maximum of 3530 feet, and averages very close to 3000 feet.

Very little trouble is found in producing these wells, other than the cutting of valves, which appears to be inseparable from the pumping of light oil from deep wells. These wells are all handled on the beam, with rods, and by means of steam engines. Wire-line pumping was tried, but was not found entirely satisfactory, differing in this from the experience of a company on the south side, where several deeper wells have been pumped in this manner with the best results.

Like all the wells in the Old Field, these wells produce a rather wet oil, the water being firmly emulsified and not susceptible to settling. The larger part of this and the Dome production goes to the Pinal-Dome refinery, at Betteravia, where it is topped in steam stills, leaving a residue of dried fuel oil. The percentage of mineral matter in these oils is very slight.

Rice Ranch Oil Company. The wells of this company are on the northwest quarter of the southwest quarter of section 19, 9–33. Here there are nine wells, all producers, drilling having been carried on at intervals from 1905 to the current year.

Wells numbered 1 to 6 were finished in the upper sands, and range in depth from 2600 to 2857 feet. Nos. 7, 8 and 9 have lately been carried down to the lower sand mentioned in connection with the Dome wells, and are said to have a much larger production than the older wells, and a lighter oil. Well No. 9 flowed for a time when first brought in, but soon settled down to a pumping basis.

Santa Barbara Oil & Mining Company. This company, which formerly operated a number of shallow producers at Summerland, drilled a well near the center of the south line of section 14, 9–34. This well was abandoned at a depth of 600 feet, because of shifting sand.

Santa Maria Central Oil Company. This company dug a 316-foot shaft on their property, the northwest quarter, southeast quarter, section 13, 9–34, but did no further development work.

Santa Maria Crude Oil Company. The well of this company was in the southwest corner of the southeast quarter, section 18, 9–33. It was abandoned at a depth of 1600 feet, because of shifting sand.

Radium Oil Company. The property operated by this company is the south half of the northwest quarter of section 23, 9–34. Here there are three wells, on which operations have continued steadily since the year 1904.

Well No. 1 was drilled to a depth of about 3900 feet, and got a very small production at the bottom of the hole. The amount of oil found was hardly enough to furnish fuel for later drilling operations.

Fox and Hobbs Leases, Union Oil Company, Santa Maria Oil Field.

Looking East on Newlove Tract, Santa Maria. Mount Solomon in Center Distance. Newlove Lease (Union) in Foreground. Las Flores in Right Center Distance. Western Union at Right.

Well No. 2 was abandoned at a depth of 800 feet, a spoiled hole.

Well No. 3 was considered completed at a depth of 3500 feet, at the beginning of 1912, but before it was tested, the casing collapsed some 700 feet off bottom. This portion of the hole is now being redrilled. the casing having parted in swaging.

Oro Water, Light & Power Company. This well is the farthest prospect to the east in the Old Field, and is about midway between the New Penn wells, and the Ideal wells in Cat Cañon. It was drilled in 1909 to a depth of 2600 feet, and got considerable water, with some gas and a very fair showing of oil, but went out of this into salt water, and was abandoned.

Associated Oil Company—Lucas. The Lucas well of this company was located on the southeast quarter of section 15, 9–34. It was abandoned at 750 feet, in quicksand with much water.

Union Oil Company of California. This company owns and operates eight tracts in the Old Field, these being the Kaiser, Fox, Hobbs and Folsom on the north side of the ridge, the California Coast, Santa Maria Oil & Gas and Hartnell on the west end, and the Newlove on the south side and apex of the ridge. They also drilled on the Arrellanes tract, west of the railroad, but got no production.

This company gives out no information regarding its properties, and the notes below regarding these tracts are necessarily scattering. It may be said, however, that conditions on these leases are in all respects similar to those on adjoining properties.

Union Oil Company—Kaiser. This is an irregular shaped tract of 100 acres in the northwest quarter of section 19, 9–33. On this there are five wells, all producing on the beam. The output of the two more northerly wells is small, that of the other three about the average for the field.

Union Oil Company—Hobbs. The Hobbs tract occupies the larger part of the northeast quarter of section 24, 9–34, with a strip of some twenty acres extending into the southeast quarter. Here there are ten wells, of which all but one, No. 10, are productive. The output of the more northerly wells is small, and only the southern half of the tract is considered producing ground. Well No. 10 was drilled in 1909 to a depth of about 4200 feet, and found traces of oil but no production. It is pulled and abandoned.

Union Oil Company—Fox. The Fox tract lies just west of the Hobbs, in the same section. Here there are eight wells, of which all but Nos. 6 and 7 are productive. These are on the north line of developments, and were practically dry holes. No. 6 had only traces of tar at 3200 feet, No. 7 is said to have been abandoned at some 700 feet.

Union Oil Company—Folsom. This tract occupies fractional section 25, 9–34, lying between the Pinal property and the Newlove ranch. On this tract there are seven wells, all productive. One of these wells was originally a flowing well of large capacity, and though it has now been producing for some six years continues to flow, though at a much diminished rate.

Union Oil Company—Hartnell. The developed portion of the Hartnell tract lies in the southwest quarter, section 23, and in the southeast quarter of section 22, 9–34. Here there are six wells, of which five are producers, while No. 3 was a lost hole at a slight depth. These holes are much deeper than the wells in the body of the field, as much as 3600 feet in some cases.

Hartnell No. 1 was, when finished, the largest flowing well brought in, up to that time, in the State. It had an initiál output of about twelve thousand barrels per day, and after nine months was still doing three thousand barrels daily. The production of the first twenty months was upwards of two million barrels, the greater part of which was saved, and considering the quality of the oil and the small supply of such oil on the market at that time, this was probebly one of the most profitable wells ever drilled.

Union Oil Company—Santa Maria Oil & Gas Company—Squires Tract. The area originally known as the Squires tract, and owned by the Santa Maria Oil & Gas Company, passed into the hands of the Union Oil Company after four or five wells had been drilled. There are now on this property fourteen wells, all believed to be productive. Well No. 1 was some 2550 feet deep, while later wells are believed to average much deeper than this. Some of these wells were originally large producers, but are now greatly depreciated.

Union Oil Company—California Coast Oil Company. The triangular piece south of the Santa Maria Oil & Gas tract, and west of the Newlove ranch, is owned by the California Coast Oil Company, which is said to be the joint property of the Union Oil Company and the Associated Oil Company. On this tract there are eight wells, operated by the Union Oil Company, and all producing. Well No. 1 was finished at 3300 feet, but the depths of later wells are not known, though they are supposed to average somewhat greater than this.

Union Oil Company—Newlove Oil Company. The Newlove ranch, occupying the center of the Old Field, is owned by the Newlove Oil Company, in which the Union Oil Company is said to own a controlling interest. Here there are forty wells, mainly along the north and south bounds of the property, of which two are drilling (January, 1912), while the remainder are all believed to be productive. These wells

occupy the crest of the anticline and a portion of the south limb, and average somewhat shallower than most of the wells to the north.

Most of these wells have been drilled within the last four years, and as they are widely scattered they have been more than usually productive, many initial productions of four, five and six hundred barrels daily having been noted. Well No. 15, finished in the latter part of 1908 at a depth of 2750 feet, is said to have started off at a daily rate of 2400 barrels, and to have held up to 250 barrels daily so long as September of the following year. The wells deepened rapidly toward the east, along the north line of the ranch, No. 22 having been finished at 3300 feet, and No. 24, the farthest to the east, at over 3600 feet. The former started off at 600 barrels per day.

The last wells drilled were immediately on the south line, and just north of Western Union property. No. 38, at a depth of 2700 feet, was said to be doing 1200 barrels per day of 27° Beaumé oil, in January of this year. As a whole, the production of these wells has fallen off very greatly, more rapidly indeed than that of the wells farthest to the west. In particular those along the west end of the south line appear to be making very little, as compared to their earlier output.

Refining & Producing Oil Company—Graciosa Oil Company. The property now held by the former company was owned and operated for several years by the Graciosa Oil Company of San Francisco. This tract is south of the Newlove ranch, and to the west of the Western Union property.

In the northeastern portion of this tract there are eighteen wells, as well as two along the south line of the tract (for the latter, see Graciosa Oil Company, Lompoc group). Of the eighteen wells first mentioned, four were abandoned when drilled, while the balance were originally very heavy producers, though now much depreciated, so much so, indeed, that several of the wells are practically inoperative.

No. 16, in the west end of the group, was a lost hole at a comparatively slight depth, but No. 17, the farthest to the west, was carried to a depth of 3786 feet, and abandoned as unprofitable. No. 12, toward the center of the group, was a lost hole at 700 feet. No. 19, about one half mile to the south of the main group, and near the east line, was abandoned as a dry hole at something over 4600 feet.

The other wells of this group were producers, at depths ranging from a minimum of 2950 feet to a maximum of 3275 feet. When first brought in, these wells were exceptionally heavy producers, several being flowing wells making up into the thousands of barrels daily. The output for these oils being limited at this time, the wells were shut in until market arrangements could be made, but when the wells were

opened up they not only would not flow, but made very little oil on the pump. It was afterward determined that water had intruded itself into the oil strata (the term sands is not applicable in this area), and though long continued attempts were made to find the source of this water, and shut it out of these wells, and the northwesterly wells on the Western Union, but indifferent success was had. Such oil as is now being produced from most of these wells is badly emulsified, and the cutput is small.

Western Union Oil Company. This company owns the entire Carreaga tract, lying east of the Graciosa Oil Company's property, and south of the Newlove ranch, but developments are confined to a strip about one half mile wide across the northern end, and of this only the west two thirds is productive.

Underground conditions over this area are complicated by important local flexures, probably accompanied by more or less faulting, and both the depth and productiveness of wells varies considerably within short distances. In this respect this area differs from the larger part of the Santa Maria field, where very uniform structural conditions are the rule.

Well No. 2 of the Western Union Oil Company was the first productive well in the Santa Maria field, excepting the little wells at Summerland, in the county. Well No. 1 was a spoiled hole, but No. 2 was finished into the first sand (this term as used in connection with Santa Maria wells will be understood to mean a fissured and more or less sandy shale, true sands being the rare exception) at a depth of 2150 feet. This well got a small production of a heavy oil, about 17° Beaumé, but was abandoned as unprofitable shortly after being finished, in the year 1901.

The wells lying between No. 2 and the northwest corner of the property all found two sands, but in most of these the upper is slightly or not at all productive. The lower sand lies roughly 3000 feet below the surface, the depth of wells finished below it ranging from a minimum of 2972 feet (in Well No. 29) to 3720 feet (in Well No. 27), and lying mostly between 3100 feet and 3300 feet.

Five of the wells in this group are abandoned. Well No. 27, the farthest south on the west line, was originally a good producer, but got into trouble after the water came in, lost a string of tools, and was finally pulled and plugged. Well No. 35 had casing trouble, and was abandoned, unfinished, at 2554 feet. Well No. 31, at the southeast corner of the group, and with one exception the farthest south on the lease, was a dry hole at 3754 feet.

Like the Graciosa wells, which drew from the same producing stratum, these wells at first made a very large amount of oil, this being

a light-brown oil of from 26° to 27° Beaumé, accompanied usually by much gas. Well No. 26 came in at 2800 barrels per day, Well No. 28 at 2500 barrels, Well No. 29 at 1000 barrels, and Well No. 30 at 2500 barrels daily. These productions were very well maintained for a long time, but were almost entirely shut off when water entered the producing beds. Not only were the gross outputs reduced to a small figure, but the oil produced contained a large percentage of emulsified water, and was at that time practically valueless, so that the wells stood idle for some time. Various separation methods were tried for removing the water, but without much success. However, after many experiments in the way of plugging and cementing, a portion of the water was shut out, and part of the production recovered. These wells are now pumpers of moderate capacity, and as they still carry considerable water, are handled by a method called "skimming," a term also applied to the removal of the volatile portion of the oil by distillation. In this method of handling, the wells are allowed to stand idle for from twenty-four to forty-eight hours, after which the pump is started, discharging first the oil remaining in the tubing from the last pumping, then clear water for a time, then a small amount of emulsified oil which is tanked separately, and finally clear oil. Pumping is suspended before the well is entirely exhausted, and a new charge allowed to accumulate. By this means the pumping of water and oil at the same time is avoided, and it is claimed that wet wells so handled give as much oil as if pumped steadily, and that emulsification is almost entirely avoided. There is no doubt that, in the case of these particular wells, at least, the water and oil lie in separate layers in the producing stratum, and that the intimate mixture of water and oil known as emulsion or sludge is produced in the main by churning in the barrel and through the valves of the pump. The agitation accomplished in the tubing alone is sufficient to bring about this result. A moment's figuring will show that 3000 feet of three-inch tubing, less the volume of a three-quarter pump rod, will hold some 1100 gallons of fluid, or the yield of a 100-barrel well for six hours and twenty minutes. Or if the well is yielding equal volumes of water and oil, the entire amount of fluid produced will lie in the tubing for over three hours. During this time it is being constantly mixed and turned over by the reciprocating action of the pump-rod boxes, and to this we must add wiredrawing through the valve ports, slip through leaky valves, and the hammer and churn due to partial filling of the pump barrel. These actions combined are amply sufficient to effect complete emulsification of such oils as are pumped in this field.

The wells drilled along the north line in the center of the tract found two, or in some cases, three sands, but drew most of their production from the upper stratum, this lying at a depth of from 1500 to 1800 feet.

Thus, No. 12, the farthest to the west of the shallow holes, is 1770 feet deep, No. 4 is 1599 feet, No. 3 is 1538 feet, No. 5 is 1742 feet, No. 6 is 1696 feet, and No. 11 is 1825 feet, these four showing a slight deepening to the southeast. This upper sand was only a small producer, and gives an extremely black but rather volatile oil of some 21° Beaumé. The deeper holes drilled among these shallow wells did not get any valuable production in the lower sands. Well No. 20, farthest to the west, was carried to 3484 feet, and found a small amount of green oil of high gravity in the lower sand. This well was pumped for some time, but was not considered profitable, and is now abandoned, though still flowing a little oil at intervals. No. 13, midway of the north line, was abandoned at 3400 feet, No. 16, the next location to the east, was drilled with a rotary, and abandoned at 1631 feet, and No. 17, farthest to the east in this line, was a dry hole at 2079 feet. South of these are three other abandoned holes, No. 16, drilled with a rotary and abandoned at 2584 feet, and Nos. 8 and 9, abandoned at 1700 feet and 1724 feet respectively. Well No. 18, drilled as a test hole, was carried to 4025 feet, but found nothing of value at depth, and is now pumped from the upper sand.

Farther to the south the deeper sands were found fairly productive, Well No. 41 being carried to 3900 feet, No. 37 to 3580 feet, No. 39 to 3810 feet, and No. 33, farthest to the southeast, to 3990 feet. These wells were much less affected by water than those in the northwest corner of the tract, and while never such liberal producers as the earlier wells, have been very well maintained. Two wells are now being drilled at the east of this group, and two between the two groups mentioned, all going for the deeper sands.

Two prospect holes at some distance from the other wells have been carried to some depth. Well No. 38, the farthest to the south on the lease, was finished at 4180 feet, and is a producer. It is not, however, considered as encouraging further work in this direction under present conditions. Well No. 42, near the northeast corner of the tract, has been suspended at 3650 feet for a long time, and has no oil whatever to this depth.

Two wells are now being drilled on the north line, matching the latest wells on the Newlove tract, these being Nos. 48 and 49. It will be noted that Newlove No. 39 is but a little distance northwest of Western Union No. 20, and though the latter was practically a dry hole at 3484 feet, Newlove No. 39 started off with a large production from the 2700-foot level. Such results as this suggest that, while the outcome of prospecting to the south on this and the Graciosa lease has not yet been favorable, there are still excellent chances of finding other productive folds in the large area between present production and the Purissima ridge.

Las Flores Land & Oil Company. Four wells have been drilled on this tract, of which three are abandoned, while one was suspended at the beginning of 1912, but was rigged, and had been recently worked on. Nos. 1 and 2 were lost holes at 700 feet and 2800 feet, respectively. No. 1A, the third hole started, was stopped at about 200 feet. Well No. 2A has been carried to a depth of about 4600 feet, and has had no oil except a small yield from a thin sand near the surface, but is showing a little gas in the brown shale. The other three holes showed no indications of oil.

Wells West of the Railroad. The line of the Pacific Coast Railway passes to the west of the wells above mentioned, and to the west of the railroad and the little valley in which it lies is a range of hills of moderate height, parallel to the coast, that is, having a generally north and south direction, at right angles to the ridge on which the Santa Maria wells are located. On the eastern face of this ridge five wells have been drilled, two or three of which showed some oil, though none got a production. As these wells were carried to a sufficient depth, and in the main drilled with great care, the results are not encouraging for this end of the field.

Associated Oil Company—Newhall. In the northeast corner of the Newhall tract, a portion of Rancho Todos Santos, a well was drilled by the Recruit Oil Company, now absorbed by the Associated. This well was carried to about 3900 feet, and had no oil, but a great deal of water. It was pulled and abandoned when finished.

Associated Oil Company—Arrellanes—Pacific Oil Transportation Company. On the Arrellanes tract, a portion of Rancho Punta de la Laguna, the Pacific Oil Transportation Company drilled a well in the year 1904. This company has since been absorbed by the Associated Oil Company. The well was 2485 feet deep, and entirely barren, and was abandoned.

Union Oil Company of California—Arrellanes—Claremont Oil Company. On the southeast corner of Rancho Punta de la Laguna, the Claremont Oil Company, a sub-company of the Union Oil Company, drilled a well to some 4100 feet depth. This well found no oil, and has been suspended for a long time.

Associated Oil Company—Escolle. On the Escolle tract, a portion of Rancho Todos Santos, the Associated drilled two deep wells. No. 2 was near the north line of the ranch, and but a short distance south of the Claremont well. This hole was carried to a depth of 3350 feet, and found a great deal of water, while the presence of oil was a matter of doubt. Repeated attempts to cement out the water failed, and the well has been suspended for a long time.

Well No. 1 is about one mile to the southeast of the foregoing, and was drilled to 3825 feet. This hole had some oil, and was claimed to be good for seventy-five barrels per day of medium gravity oil, but the water could never be shut out, though cemented several times. Like No. 2, this well has been long suspended, and is considered a failure.

West Huasna Oil Company. The well of this company is on the same ranch, and about one mile southeast of Escolle No. 1. It was drilled to a depth of 3970 feet, and undoubtedly had some oil, but was completely drowned out, and was finally pulled and abandoned. This company also drilled in the Huasna country, San Luis Obispo County, and is now operating in the Bardsdale district, Ventura County.

Productiveness of Wells. The production records for the Santa Maria field are somewhat confused by the fact that the outputs from the Old Field, Cat Cañon and Lompoc have never been recorded separately. The number of wells in the latter, however, has always been so small that the error thus introduced is not of consequence, and except for the years 1909 and 1910, when the output of two wells in Cat Cañon bolstered the production by perhaps six or seven barrels per day, the averages for the three fields taken together will not be far from that of the Old Field alone.

No reliable averages can be had prior to the year 1906, as before this time so much drilling was under way at all times that it is out of the question to get at any average number of wells in operation during the year. For instance, in 1903 the total production was only 208,890 barrels, while in December of that year there were 21 nominal producers, or an average of a little over 27 barrels per well per day. To be sure, fifteen of these producers were the shallow sand wells on the south side, always small producers, yet there is little doubt that the average for every day in the year was much larger than this.

In 1906, unofficial figures give an output for Santa Maria and Lompoc of 5,400,000 barrels, which was surely large enough. In March of that year there were 66 producers in the Old Field, and 15 in Lompoc, a total of 81, giving an average output of 183 barrels per well per day. As compared with later figures, this average is probably somewhat high, the output being rather more liberally estimated, and the number of wells taken in March instead of at the end of the year.

No certain count of the wells producing is available for intervening years, but in 1909 there were 205 wells nominally producing at the end of December, while the production for the year was 8,080,488 barrels. This again is for the two fields, Cat Cañon not yet being on the producing list, and is an average of 107 barrels per well per day.

At the end of 1910 there were 229 wells classed as producers, and the output for that year was 7,592,637 barrels, or a daily average per well of almost 91 barrels.

At the end of the year 1911 there were 250 producers in the three fields, the Old Field showing 201 in this class, Cat Cañon 12, and Lompoc 37. The production for the three fields was 6,259,776 barrels, or a daily average of 69 barrels per well. Or if we take out the twelve Cat Cañon wells, and an estimated 1,000,000 barrels from this field (which is high), the average for the other two fields is reduced to 65 barrels per well per day, or a difference of only four barrels on this account. And there is no reason for thinking that the average output on the Lompoc wells is materially different from that of the wells in the Old Field.

There is no doubt that the Santa Maria district, with the exception of Cat Cañon, is a declining field, but these figures do not bear out the assumption that the decline is over rapid, or that it requires any unusual explanation. The greater part of the wells in this territory are now upwards of six years old, and a decline of two-thirds in this time, when not offset by any large amount of new work, is no more than normal. It cannot be questioned that the intrusion of water into the productive strata, on both sides of the ridge, gave a severe setback to production at first, but while little of this lost production has been recovered, there is no reason to believe that any further depreciation of moment is now taking place from this cause. The wells are slowly growing less productive, as the gas pressure decreases and exhaustion of the sands increases, and as the output of oil drops, the percentage of water naturally becomes somewhat greater, but both of these changes are now taking place very slowly, and it can hardly be doubted that the larger part of the present output will still be available for some years to come. As matters stand at present, the per well output is just about that of Coalinga, while the average price of the oil is materially greater, with a maintenance charge ranging from normal to rather low.

QUALITY OF SANTA MARIA OIL.

The oils of this field show a rather narrow range of gravity, from 20.0° to 34.6° Beaumé. North of the ridge this range is even narrower, the highest gravity noted being 28.5°, and the lowest 21.1° Beaumé.

In the northern part of the field the quality is highly uniform, except as some of the wells suffer more or less from water trouble. All the oils are characterized by a greenish tinge, and give high yields of naphthas, kerosene and asphalt, with very little middlings. The naphthas are white and sweet, the kerosene rather difficult to refine. The lubricating stock contains much amorphous paraffin and is of no value. These oils run very high in combined sulfur.

South of the ridge two classes of oil are found, one a black or greenish-black oil ranging from 20° to 24° Beaumé, the other a brownish oil exactly resembling the oils north of the ridge, but running into higher gravities. These lightest oils do not show as much increase in gasoline

percentage over the heavier as might be anticipated from the difference in gravity, and in this respect (gasoline yield) are inferior to oils of the same gravity found in Fullerton. In this field the lighter oils usually show less sulfur than the heavier grades.

4466*

Pinal Oil Company. Well No. 8.

Gravity ---------- 21.1° Beaumé

This is a fairly limpid, greenish-black oil, with a strong, unpleasant odor.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distilled to dry coke.

First cut	7.0 per cent	56.6° Beaumé
Second cut	6.3 per cent	51.4°
Third cut	18.0 per cent	41.0°
Fourth cut	10.8 per cent	31.9°
Fifth cut	50.3 per cent	25.5°
Fixed carbon	7.6 grams per 100 c.c.	

100.0 per cent

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	4.0 per cent
Engine distillate	52°	11.0 per cent
Kerosene	42°	12.0 per cent
Stove oil	33°	15.0 per cent
Fuel distillate	29.0°	22.4 per cent) Slop distillate
Reduced stock	13.5°	16.6 per cent) 25.5°—39.0%
Asphalt	"D"	19.0 per cent, or 62.6 lbs. per bbl.

100.0 per cent

The light products from this oil were somewhat off color, but were sweet, and treated out well. The heavy distillate was a good deal burned. and gave a reduced stock of dark color and medium viscosity, not showing paraffin.

4462*

Hall & Hall Oil Company (Treasure Realty). Well No. 2.

Gravity ---------- 21.5° Beaumé

This is a rather limpid, brownish oil, with a strong, sharp odor.

Distillation.

Sample of 150 c.c. distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	8.7 per cent	51.7° Beaumé
Second cut	8.3 per cent	42.4°
Third cut	9.8 per cent	33.7°
Fourth cut	63.5 per cent	23.4°
Fixed carbon	9.7 grams per 100 c.c.	

100.0 per cent

*Analysis by J. P. P.

On calculation of the coke to asphalt, this oil shows the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	9.0 per cent
Kerosene	42°	8.0 per cent
Stove oil	34°	10.0 per cent
Middlings and lubricants	23.4°	50.0 per cent (not separated)
Asphalt	"D"	23.0 per cent, or 75.6 lbs. per bbl.
		100.0 per cent

The light products from this oil were fairly pale, and treated out to white, sweet oils with the test acid. The lubricating stock was considerably burned, and was not further examined.

4467*

Pinal Oil Company. Well No. 16.

Gravity ---------- 22.6° Beaumé

This is a fairly limpid, brownish-black oil, with a strong and unpleasant odor.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distilled to dry coke.

First cut	4.2 per cent	60.7° Beaumé
Second cut	9.1 per cent	52.3°
Third cut	19.0 per cent	41.6°
Fourth cut	8.4 per cent	32.4°
Fifth cut	52.5 per cent	25.1°
Fixed carbon	6.8 grams per 100 c.c.	
	100.0 per cent	

On calculation of the coke to asphalt, these figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	4.0 per cent
Engine distillate	52°	10.0 per cent
Kerosene	42°	17.0 per cent
Stove oil	33°	10.0 per cent
Middlings and lubricants	25.1°	42.0 per cent (not separated)
Asphalt	"D"	17.0 per cent, or 56.7 lbs. per bbl.
		100.0 per cent

5457*

New Penn Petroleum Company. Well No. 1.

Gravity ---------- 23.1° Beaumé

This is a moderately limpid oil, of greenish-black color, and strong, sulfurous odor.

Distillation.

Sample of 150 c.c. distilled from copper, first three cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	17.3 per cent	51.6° Beaumé
Second cut	10.3 per cent	41.8°
Third cut	12.5 per cent	32.7°
Fourth cut	54.0 per cent	23.0°
Fixed carbon	5.9 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	15.0 per cent	
Engine distillate	52°	8.0 per cent	
Kerosene	42°	14.7 per cent	
Stove oil	33°	7.0 per cent	
Fuel distillate	29.5°	15.6 per cent	Slop distillate
Reduced stock	16.2°	25.4 per cent	22.5°—41.0°
Asphalt	"D"	14.3 per cent, or 50.2 lbs. per bbl.	
		100.0 per cent	

The distillates from this crude had a pale color as they came from the still, but carried a sharp and penetrating odor, which disappeared with the test treatment, giving water-white and very sweet oils. The last cut had a pale and rather yellowish color, and a peculiar sulfurous odor suggesting garlic. The reduced stock was of normal color and viscosity, with slight crystallization, and treated out to an 18.0° red oil of fine color, showing a little paraffin.

7404*

Pinal Oil Company. Wells No. 1 and No. 3.

Gravity	27.6° Beaumé
Viscosity at 60° F.	3.27° Redwood
Viscosity at 185° F.	1.36 Redwood
Sulfur	1.56 per cent by weight
Thermal value	18,997 British thermal units

Distillation.

Sample of 200 c.c. distilled from a glass flask, without steam or gas.

Below 212° F.	8.2 per cent	66.6° Beaumé
212. to 302°	17.7 per cent	53.8°
302 to 392°	12.1 per cent	42.2°
392 to 482°	9.4 per cent	34.0°
482 to 572°	9.1 per cent	25.6°
572° to grade	29.7 per cent	24.1°
Asphalt	12.0 per cent	Grade "D" (about)
Loss	1.8 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	16.0 per cent
Engine distillate	52°	9.0 per cent
Kerosene	42°	13.0 per cent
Stove oil	33°	10.0 per cent
Middlings and lubricants	24.4°	38.2 per cent (not separated)
Asphalt	"D"	12.0 per cent
Loss	---	1.8 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

5459*

Rice Ranch Oil Company. Well No. 4.

Gravity ---------- 25.2° Beaumé

This is a rather limpid, greenish-black oil, with a strong, unpleasant odor. The sample as received contained some emulsified water, which was separated before distillation.

Distillation.

Sample of 200 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	5.1 per cent	58.3° Beaumé
Second cut	6.5 per cent	51.8°
Third cut	22.7 per cent	41.8°
Fourth cut	8.1 per cent	32.3°
Fifth cut	48.9 per cent	21.9°
Fixed carbon	8.7 grams per 100 c.c.	

100.0 per cent

On reduction of the last cut in a current of gas, and caulculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	2.0 per cent (about)
Engine distillate	52°	12.0 per cent
Kerosene	42°	18.3 per cent
Stove oil	33°	10.1 per cent
Fuel distillate	29.9°	15.4 per cent / Slop distillate
Reduced stock	14.6°	20.4 per cent \ 21.9°—32.3°
Asphalt	"D"	21.8 per cent, or 76.5 lbs. per bbl.

100.0 per cent

The light products from this oil ran quite yellow, but very sweet, and took the test acid only fairly well. The heavy stock was of good color, but of low viscosity, and a strong, sulfurous odor. This gave a reduced stock of high viscosity, with some paraffin, which treated out to a 16.0° red oil of fine color, but with a high cold test.

5455*

New Penn Petroleum Company. Well No. 6.

Gravity ---------- 26.6° Beaumé

This is a fairly limpid oil of a greenish-black color, with a strong and rather sulfurous odor.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	15.0 per cent	61.0° Beaumé
Second cut	8.1 per cent	51.8°
Third cut	14.6 per cent	41.9°
Fourth cut	8.9 per cent	31.6°
Fifth cut	47.7 per cent	22.5°
Fixed carbon	5.7 grams per 100 c.c.	

100.0 per cent

*Analysis by J. P. P.

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is obtained:

Gasoline	61° Baumé	None	
Engine distillate	52°	16.5 per cent	
Kerosene	42°	12.0 per cent	
Stove oil	33°	10.5 per cent	
Fuel distillate	29.2°	21.3 per cent	Slop distillate
Reduced stock	14.4°	24.9 per cent	23.0°—46.2%
Asphalt	"D"	14.8 per cent, or 51.9 lbs. per bbl.	
		100.0 per cent	

The light products from this crude run dark and with a strong odor, but with the test acid came out with good odors and fair colors. The lubricating distillate was rather dark, with a moderate viscosity, and strong, sulfurous odor. This gave a reduced stock of good color, and with a rather high viscosity, which treated out to a dark red engine oil of good body, 17.3° Baumé.

4461*

Pinal Oil Company. Well No. 20.

Gravity ..... 24.1° Baumé

This is a limpid, brownish-black oil, with a sharp and rather strong odor. Sample as received contained considerable emulsified water, which was separated prior to distillation.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation carried to dry coke.

First cut	8.6 per cent	58.4° Baumé
Second cut	9.3 per cent	52.4°
Third cut	10.3 per cent	42.4°
Fourth cut	22.6 per cent	33.1°
Fifth cut	41.3 per cent	24.6°
Fixed carbon	7.9 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Baumé	5.0 per cent	
Engine distillate	52°	17.0 per cent	
Kerosene	42°	6.0 per cent	
Stove oil	33°	23.3 per cent	
Fuel distillate	29.2°	16.3 per cent	Slop distillate
Reduced stock	15.5°	12.7 per cent	24.6°—29.0%
Asphalt	"D"	19.7 per cent, or 67.3 lbs. per bbl.	
		100.0 per cent	

The light products from this oil ran rather dark, but cleared up well with the test acid. Decomposition took place in the last two cuts, and the last was considerably burned. The reduced stock was dark and of low viscosity, but treated out to a deep red engine oil of 16.6° Baumé, with low viscosity, and only a trace of paraffin.

*Analysis by J. P. P.

4460*

Dome Oil Company. Well No. A-7.

Gravity ---------- 28.5° Beaumé

This is a limpid, greenish-black oil with a rather sharp odor.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation carried to residue of dry coke.

First cut	6.6 per cent	64.0° Beaumé
Second cut	8.4 per cent	52.7°
Third cut	23.7 per cent	42.3°
Fourth cut	8.7 per cent	33.3°
Fifth cut	45.8 per cent	26.4°
Fixed carbon	6.8 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the asphalt to coke, the following commercial analysis is shown.

Gasoline	61° Beaumé	9.0 per cent
Engine distillate	52°	2.5 per cent
Kerosene	42°	25.0 per cent
Stove oil	33°	8.0 per cent
Fuel distillate	29.3°	25.2 per cent (Slop distillate
Reduced stock	---	14.8 per cent) 26.4°—40.0%
Asphalt	"D"	15.5 per cent, or 54.4 lbs. per bbl.
		100.0 per cent

The light products from this oil ran pale, and treated out to white and sweet oils. The lubricating stock was a good deal burned, and gave a reduced stock of a brownish-green color and medium viscosity, showing some crystallization.

7402.†

Western Union Oil Company. Well No. 3.

Gravity	20.0° Beaumé
Viscosity at 60° F.	38.40 Redwood
Viscosity at 185° F.	2.81 Redwood
Sulfur	2.08 per cent by weight
Thermal value	19,664 British thermal units

Distillation.

Sample of 200 c.c. distilled from a glass flask, without steam or gas.

Below 212° F.	0.9 per cent	
212 to 302°	6.0 per cent	54.3° Beaumé
302 to 392°	10.5 per cent	43.1°
392 to 482°	9.3 per cent	34.0°
482 to 572°	11.0 per cent	27.7°
572° to grade	39.5 per cent	22.7°
Asphalt	22.0 per cent	Grade "D" (about)
Loss	0.8 per cent	
	100.0 per cent	

*Analysis by J. P. P.

†Analysis by H. N. Cooper.

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	1.0 per cent
Engine distillate	52°	7.0 per cent
Kerosene	42°	9.5 per cent
Stove oil	33°	10.0 per cent
Middlings and lubricants	23.8°	49.7 per cent (not separated)
Asphalt	"D"	22.0 per cent
Loss	---	0.8 per cent
		100.0 per cent

7443*

Western Union Oil Company. A well.

Gravity	20.5° Beaumé
Viscosity at 60° F.	28.62 Redwood
Viscosity at 185° F.	2.03 Redwood

The number of the well from which this sample was taken is not recorded. It was probably one of the shallower wells at the northeast.

Distillation.

Sample of 200 c.c. distilled from glass flask, without steam or gas.

Below 302° F.	12.0 per cent	57.1° Beaumé
302 to 392°	10.4 per cent	40.2°
392 to 482°	8.3 per cent	32.8°
482 to 572°	24.5 per cent	27.5°
572° to grade—a	22.6 per cent	22.7°
572° to grade—b	4.8 per cent	22.3°
Asphalt	17.9 per cent	Grade "D" (about)
Gain	0.5 per cent	
	100.0 per cent	

These figures are roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	6.0 per cent (approximate)
Engine distillate	52°	4.0 per cent (approximate)
Kerosene	42°	12.5 per cent
Stove oil	33°	8.0 per cent
Middlings and lubricants	24.9°	51.6 per cent (not separated)
Asphalt	"D"	17.9 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

5458*

Western Union Oil Company. Well No. 7.

Gravity ---------- 22.4° Beaumé

This is a fairly limpid oil, with a greenish-black color, and a strong but not sulfurous odor. This sample as received contained some emulsified water, which was separated before distillation.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to residue of dry coke.

First cut	16.1 per cent	61.0° Beaumé
Second cut	6.0 per cent	47.9°
Third cut	8.5 per cent	32.6°
Fourth cut	11.2 per cent	29.2°
Fifth cut	48.3 per cent	22.0°
Fixed carbon	9.9 grams per 100 c.c.	

100.0 per cent

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the commercial analysis is as follows:

Gasoline	61° Beaumé	16.1 per cent
Engine distillate	52°	None
Kerosene	42°	12.5 per cent
Stove oil	33°	6.5 per cent
Fuel distillate	29.7°	12.4 per cent / Slop distillate
Reduced stock	15.3°	27.7 per cent \ 22.0°—40.1%
Asphalt	"D"	24.8 per cent, or 87.0 lbs. per bbl.

100.0 per cent

The light products ran yellow from the still, but treated out fairly white and perfectly sweet. The lubricating distillate was rather dark, with a high viscosity, and considerable paraffin. This gave an almost solid reduced stock, of fine color, which treated out to a rich orange engine oil, of 19.1° Beaumé, which solidified at 60° F.

4457*

Western Union Oil Company. Well No. 43.

Gravity ---------- 24.3° Beaumé

This is a moderately limpid, brownish oil, with a sweet and rather strong odor. The sample as received contained considerable emulsified water, which was removed before distillation.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	6.0 per cent	58.9° Beaumé
Second cut	12.0 per cent	51.5°
Third cut	12.4 per cent	41.7°
Fourth cut	15.8 per cent	32.2°
Fifth cut	45.4 per cent	27.3°
Fixed carbon	8.4 grams per 100 c.c.	

100.0 per cent

*Analysis by J. P. P.

On calculation of the coke to asphalt, these figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	3.5 per cent
Engine distillate	52°	16.0 per cent
Kerosene	42°	9.4 per cent
Stove oil	33°	14.5 per cent
Middlings and lubricants	27.3°	35.6 per cent (not separated)
Asphalt	"D"	21.0 per cent, or 73.7 lbs. per bbl.
		100.0 per cent

4458*

Western Union Oil Company. Well No. 34.

Gravity ---------- 25.8° Beaumé

This is a moderately limpid, brownish oil, with a sweet and strong odor.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	9.3 per cent	63.9° Beaumé
Second cut	8.3 per cent	52.5°
Third cut	19.3 per cent	42.2°
Fourth cut	12.2 per cent	33.0°
Fifth cut	41.5 per cent	21.9°
Fixed carbon	9.0 grams per 100 c.c.	
	100.0 per cent	

On calculation of the coke to asphalt the following commercial analysis is obtained:

Gasoline	61° Beaumé	12.5 per cent
Engine distillate	52°	3.5 per cent
Kerosene	42°	12.0 per cent
Stove oil	33°	12.2 per cent
Fuel distillate	21.9°	37.3 per cent (not separated)
Asphalt	"D"	22.5 per cent, or 79.0 lbs. per bbl.
		100.0 per cent

The light products from this oil ran dark colored and with a strong odor, which was not much improved by the test acid. Cracking started in the 33° cut, though not to such an extent as to much alter the yield of this oil.

The lubricating stock contained so much paraffin as to freeze in the condenser, and was not considered to be worth examining.

*Analysis by J. P. P.

4468*

Western Union Oil Company. Well No. 21.

Gravity ---------- 26.7° Beaumé

This is a limpid oil of a brownish-black color and a strong but rather sweet odor.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distilled to dry coke.

First cut	5.2 per cent	62.4° Beaumé
Second cut	16.8 per cent	52.1°
Third cut	10.5 per cent	41.2°
Fourth cut	19.5 per cent	32.9°
Fifth cut	41.9 per cent	25.9°
Fixed carbon	6.1 grams per 100 c.c.	

100.0 per cent

On reduction of the last cut in a stream of inert gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	7.0 per cent	
Engine distillate	52°	13.5 per cent	
Kerosene	42°	10.5 per cent	
Stove oil	33°	19.0 per cent	
Fuel distillate	29.5°	20.5 per cent	Slop distillate
Reduced stock	---	14.2 per cent	25.9°—34.7%
Asphalt	"D"	15.3 per cent, or 53.7 lbs. per bbl.	

100.0 per cent

The light products ran a little dark, but treated out in a satisfactory manner. The lubricating stock was pale and thin, and gave a reduced stock of rich olive, pale color, which solidified at 47° F.

4470*

Western Union Oil Company. Well No. 38.

Gravity ---------- 33.5° Beaumé

A very limpid oil with a strong greenish tinge, and a sweet, gassy odor. The water in this sample was not emulsified.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	8.2 per cent	63.2 Beaumé
Second cut	16.2 per cent	52.4°
Third cut	19.7 per cent	42.0°
Fourth cut	35.2 per cent	33.0°
Fifth cut	17.1 per cent	Solid
Fixed carbon	3.6 grams per 100 c.c.	

100.0 per cent

*Analysis by J. P. P.

On calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	11.5 per cent (about)
Engine distillate	52°	10.0 per cent
Kerosene	42°	22.7 per cent
Stove oil	33°	35.3 per cent
Middlings and lubricauts	Solid	11.5 per cent (not separated)
Asphalt	"D"	9.0 per cent, or 31.6 lbs. per bbl.
		100.0 per cent

The light products ran pale from the still, and treated out well. The stove oil was more or less burned, and the oil seems to be tender at this point. The lubricating stock froze solid as it dropped from a hot condenser and was not further examined.

7403*

Western Union Oil Company. A well.

Gravity	34.6° Beaumé
Viscosity at 60° F.	1.72 Redwood
Viscosity at 185° F.	1.17 Redwood
Sulfur	0.60 per cent by weight
Thermal value	19,485 British thermal units

The number of the well from which this sample was taken is uncertain, but it was one of the deeper southern wells, probably between No. 36 and No. 40.

Distillation.

Sample of 200 c.c. distilled from a glass flask, without steam or gas.

Below 212° F.	8.6 per cent	64.8° Beaumé
212 to 302°	16.0 per cent	52.2°
302 to 392°	12.0 per cent	44.4°
392 to 482°	13.4 per cent	37.6°
482 to 572°	10.8 per cent	33.3°
572° to grade—a	23.0 per cent	29.3°
572° to grade—b	7.4 per cent	28.7°
Asphalt	8.0 per cent	Grade "D" (about)
Loss	0.8 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	14.0 per cent
Engine distillate	52°	5.5 per cent
Kerosene	42°	30.5 per cent
Stove oil	33°	11.0 per cent
Middlings and lubricants	29.1°	30.2 per cent
Asphalt	"D"	8.0 per cent
Loss	---	0.8 per cent
		100.0 per cent

*Analysis by H. N. Cooper.

Photo by F. W. P.

Cat Cañon Oil Field. Looking Northeast. Santa Barbara Co

Cat Cañon Oil Field. Looking Northeast. Santa Barbara County.

CHAPTER XX.

CAT CAÑON WELLS.

The wells of the Cat Cañon or East field are located in a strip some two miles wide and four miles long, ranging from northwest to southeast across townships 9–33 and 9–32. Only a small portion of this area has been brought to production at this time, but the work done has been sufficient to show that the larger part, at least, is underlain by productive oil sands.

The history of this field has been very peculiar. The first discovery was made some five years ago, a very large flowing well was brought in during the following year, and a number of holes have been drilled, most of which indicates the existence of very productive sands. Yet, with about thirty completed holes in the field, some of which have been finished two years or more, all but a very small proportion of the production has come from three wells, and a number of the completed wells (completed, that is, as to depth), though known to penetrate thick layers of rich sand, are not now being operated.

Various reasons may be assigned for this condition of affairs, and several deductions drawn, some of them not very flattering to the prospects of the territory as a whole. But as the records speak for themselves, they should be presented before any generalities are given.

Carpinteria Oil Company. This corporation has a drilling well on the northwest quarter of the northeast quarter of section 32, 9–33. This well was started in 1909, and carried to a depth of about 3200 feet, at which depth a portion of the inner string was split, and the casing parted while attempting to draw. It is now reported that this well is to be abandoned, the formation at the bottom of the hole being quite different from that found in other Cat Cañon wells, and very difficult to handle. No oil was encountered in this well. The Carpinteria Oil Company also drilled two wells near the town of that name, on the Santa Barbara coast, in 1905 and 1906.

Sisquoc Oil Company. This company has a 600–foot well on the west side of the Long Cañon road, on the southeast quarter, southwest quarter, section 19, 9–33. This well has been suspended since 1908, but is still rigged for drilling.

Cat Canyon Oil Company. This well is immediately across the cañon from the Sisquoc hole, and on the southwest quarter, northwest quarter, section 20, 9–33. It was started in the latter part of 1910, but after a depth of a few hundred feet was reached was suspended. It still stands rigged.

Palmer Union Oil Company; Stendell tract. Well No. 1 on this lease is situated on the northwest quarter, southwest quarter of section 29, 9–32. It was started during 1910, and carried to a depth of 3480 feet. It is known that an oil sand, possibly several, were encountered, but much water was struck above the oil sand, and probably some below. This hole was cemented several times, but all efforts to shut off the water failed, and no production was ever had. At present it is standing idle.

Well No. 2 on the Stendell is on the southeast quarter, southeast quarter of section 30, 9–32, a short distance north of Brooks No. 1. This well is practically completed as to depth, but has not yet been brought to production.

Brooks Oil Company. Both wells of this company are on the northeast quarter, northeast quarter, section 31, 9–32. No. 1 was drilled in 1909, and found some oil and a great deal of water at 3090 feet. After many attempts to shut out this water, the hole was finally converted into a water well, and is now supplying fresh water for this and adjacent leases on an air-lift.

Well No. 2 was stopped at about 2400 feet, and was put on the pump. This well would undoubtedly be a liberal producer if the oil could be gotten out of the hole, and a considerable quantity has been taken out. In fact, this is the only well in Cat Cañon proper from which oil has been sold in commercial quantity. The extreme viscosity of the oil, however, makes all drilling and pumping operations most difficult, and as the well has considerable water and some sand, it has proven a difficult problem to keep it in operation.

Henderson Oil Company. The well of this company is on the southeast quarter, southwest quarter of section 30, 9–33. It was originally carried to the "fourth-sand," at a depth of 3560 feet, but failing to produce from this sand, was perforated in the "third-sand" at 2460 feet. After working on the well a long time it was finally suspended, after being very badly damaged, and may be considered a lost hole. Some oil was produced from this well, the quality being about the same as that from other wells in Cat Cañon. The property is now under lease to the Santa Maria Petroleum and Pipeline Company.

Santa Maria Petroleum and Pipeline Company. The well of this company, on the southwest quarter of the southeast quarter of section 30, was not being operated when visited, and no certain statement of the conditions could be had. It appears to be a deep hole, and to have some oil, but has not produced.

Santa Maria Enterprise Oil Company. The well of this company is on the Blodgett tract, northwest quarter, northwest quarter, section 31, 9–32. This hole collapsed at a depth approximating 3000 feet, and is now being redrilled.

Associated Oil Company; Williams. The Associated well on Williams land, northwest quarter of the southeast quarter of section 31, 9–32, was the pioneer well in this field, being drilled by the Recruit Oil Company (since absorbed by the Associated) in the year 1907. It was carried to a depth of about 3400 feet, but found only a very stiff tar at that depth, and was pulled and plugged.

New Pennsylvania Petroleum Company; Fugler. This well is on the northwest quarter of the southwest quarter of section 30, 9–32, and has been drilling for almost three years. It was originally carried to 3555 feet, but at this depth the oil was so extremely heavy that it was impossible to work either pumps or balers in it, the tar being stiff enough to roll into balls in cold weather. As it was thought that the presence of water might tend to cause this condition, the pipe was pulled back to 3000 feet, and when visited last the well was being rigged for pumping at this depth. It had flowed some oil a short time previously, this oil being very heavy, but considerably less viscous than the tar first produced.

West Oil Company. This company has a well immediately north of the New Pennsylvania well, on the southwest quarter, northwest quarter, section 30, 9–32. This well was originally drilled to 3360 feet, and was reported as a producer, but the output proved to be tar similar to that from the well adjacent. While working with the well it collapsed; the casing was then cut off and the hole redrilled to 2937 feet, where it now stands. While this well has undoubtedly reached productive sands, it is not, in its present shape, a producer.

Pinal Oil Company; Fleisher. This company has two wells on the Fleisher tract, the north half, north half, section 30, 9–32. Well No. 1 was drilled in 1910 and 1911, and reached a depth of 2100 feet. It appeared to have considerable oil, but found also a great deal of water. Attempts were made again and again to shut off this water, but the cement could not be made to hold, and the hole was finally pulled and plugged. Well No. 2 had been started immediately north of the abandoned hole, in January, 1912.

Cat Cañon proper thus has fifteen wells, of which four are drilling, without any oil as yet; three have the oil sand, and are trying to make producers; two are suspended at a slight depth; one is suspended in oil sand; four are abandoned, and one is pumping a portion of the time, with much sand trouble.

This is the record of five years' work, and as it is quite certain that prolific sands are passed through in these wells, the condition is remarkable enough to have called forth considerable comment and discussion, though it must be admitted that no agreement has yet been reached. Some facts, however, are sufficiently apparent.

The wells are deep, and find a great deal of water above the oil sands, and some difficulty seems to be experienced in finding strata of sufficient density and firmness, between water and oil sands, to enable the proper shutting off of water. The other main difficulty is found in the extreme viscosity of the oil. An examination of the figures for the Brooks oil will indicate how far this tendency obtains, particularly when it is remembered that this is the most fluid oil found in this group, some of the tars being much more solid. It will be apparent enough that with such material in the hole, it would be most difficult to obtain any adequate log of the well after striking first oil, and as a matter of fact almost nothing appears to be known as to the formation below the top oil sand. Indeed, it is not, as yet, at all certain whether the earlier and deeper wells actually went into bottom water, or whether the water found in all of them came from above. It is probable, however, that at least one or two did pass through the oil-bearing formation into sands carrying water under considerable pressure, and that the presence of this water in the oil sands has greatly aggravated the difficulty of handling later wells.

This oil is of considerable value for asphalt making, as will be indicated by the analysis of the Brooks sample. It is impossible to tell at this time whether any important production will be had in the future from wells on this formation.

Nicholson well. The first well drilled anywhere in this vicinity was located on section 35, 10–32, opposite Fugler's Point, where the Sisquoc River enters the Santa Maria. Along the road south of the river, and near the site of the well, are some narrow seams of solid asphalt. The well noted seems to have struck this same formation at a depth of 210 feet, and after penetrating it a few inches was abandoned on account of the toughness of the material. The asphalt found in the well was not hard like that cropping along the road, but was of a soft and rubbery consistency.

Bradley Cañon Oil Company. This company was rigging, in January, 1912, on the east side of Bradley Cañon, about one mile south of the Sisquoc road.

Summit Oil Company. This company is drilling on the southwest quarter of the southeast quarter of section 11, 9–33. At last reports this well was having trouble with casing at about 2400 feet. No oil had been found at that depth.

Merchants' Oil Company. In January, 1912, the Merchants' well on the southeast quarter, northwest quarter of section 14, 9–33 had reached a depth of 2660 feet, and had entered the first oil sand. Drilling is still under way.

Despatch Oil Company. This company is drilling on the northeast quarter, northwest quarter, section 23, 9–33. At the beginning of the year 1912 this well was 3300 feet deep, had reached the first oil sand, and upper water was being cemented off on the 4½-inch pipe.

Ideal Oil Company. This company has drilled two wells, both on the southwest quarter, northwest quarter, section 23, 9–33. Well No. 1 was drilled in 1908 and 1909, and was 2502 feet deep. It found its first oil in brown shale at 1404 feet, again in shale at 1665 feet, and in small quantities in a gray sand at 1787 feet. The first productive sand was a 13-foot layer entered at 1985 feet, and below this streaks of sand and shale carrying oil were met at intervals to 2445 feet. At the final depth reached, however, the well was not considered a producer, and as it was reduced to a very small casing, and had met much trouble with water and running sand farther up, the hole was abandoned as hopelessly pointed.

Well No. 2 was started in the latter part of 1909, and is still drilling, having reached a somewhat greater depth than No. 1. This well went into bottom water, which to the present time has not been successfully cemented, and has had much trouble with crooked hole.

Los Alamos Petroleum Company. The property of this company has been absorbed by the Palmer Annex Oil Company. The well on this forty, the northwest quarter, southwest quarter, section 23, 9–33, is the farthest west of any producer in the field, and when brought in, nearly two years ago, looked like a large well. The oil, however, is so extremely heavy and viscous that, to this time, all efforts to get the well to produce have been but temporarily successful. When last visited the well had been on air lift for some time, and had made considerable oil, but excessive air pressure had split the pipe, and preparations were then being made to start on hot air, after recasing. The pressure carried on the bottom of the pipe had been in the neighborhood of 1500 pounds. The well is 3185 feet deep, got its first showings in brown shale at 1685 feet, and a 25-foot oil sand, not very productive, at 2415 feet, but gets the larger part of its oil from a true sand lying between 3065 feet and 3180 feet. The oil from this well is similar to other oils found in this district, but is heavier than the oils found farther east, being almost stiff enough to walk on when chilled.

Rice Ranch Oil Company. The two wells of this company, on land now belonging to the Palmer Annex Oil Company, were drilled in 1904. Well No. 1 was about 500 feet deep, and stopped in the heaving sand, many boulders also being found. At this time the method of circulation, since used to pass this surface sand, had not been invented. Well No. 2 was drilled with a rotary rig to about 1000 feet, and also stopped because of boulders. Neither of these holes, of course, found any oil.

The Rice Ranch Oil Company is now operating a tract in the Old Field, Santa Maria.

Palmer Annex Oil Company—Santa Maria Oil Fields. The Santa Maria Oil Fields, a British corporation, is said to be the holding company for the Palmer Annex Oil Company, of Los Angeles. In January, 1912, the latter company was drilling six wells along its east and south lines, against Palmer Union and Dome properties. Nos. 1 and 2 had reached depths of 2750 feet and 3100 feet, respectively, and were in oil sand, but had much mechanical trouble, and were not yet on the producing list. Nos. 3, 4, 5 and 6 were between 1000 and 2000 feet in depth, and had not yet struck oil. No. 7 was rigged, but had not yet started to drill.

Dome Oil Company. This company, which also operates producing properties in the Old Field (Santa Maria), in the Lompoc group (see Gem Oil Company), on the Wickenden tract (see Santa Ynez group) and in North Midway, has seven wells on the Blochman tract, on the northwest quarter of section 26, 9–33.

Well No. 1 is a flowing well of modest output, but produces a perfectly clean oil, and has flowed steadily for a long time. This well produces a lighter oil than the average for this lease, the gravity being 15.0° Beaumé.

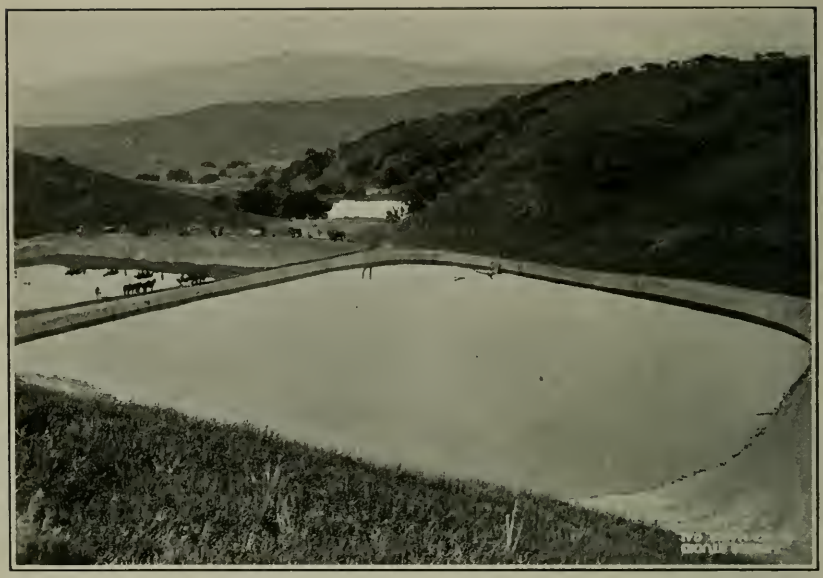
Well No. 2 flowed for a short time when finished. Fearing that the well would get beyond control, it was filled with water while the casing head was being attached, but when put on the pump and freed from water proved to be only a small producer, and is probably choked. This well also makes a perfectly clean oil of 15.5° Beaumé, accompanied by much gas, and is a steady producer on the pump.

Well No. 3 was carried into the top sand only, the casing being open at the bottom and not perforated. It flows very steadily a moderate amount of oil of 10.8° Beaumé, accompanied by a little sand and considerable gas, but free from water.

Well No. 4 is near the southwest corner of the tract, and about opposite the Union's Bell No. 4. It is not finished, and stands rigged. The depth is not known, but probably approximates that of other wells in the vicinity, as it has evidently made some oil.

Well No. 5 is on the east line, north of No. 3 and opposite Palmer No. 4. When last visited it had just been put on the pump, and was producing the lightest oil on the lease, the gravity being about 16° Beaumé. This well had not at that time been pumped long enough to establish its production rate, as this was constantly increasing, and the well showed a tendency to flow.

Well No. 6 is on the north line, offsetting Palmer Annex No. 2. It had not been finished when last visited, but had a good showing in the



An Oil Reservoir. Cat Cañon Field.

Palmer & Dome Wells, Cat Cañon.

sump. Well No. 7 is also on the north line opposite Palmer Annex No. 6. This well was spudded in about the first of the year.

Palmer Union Oil Company. This corporation is a consolidation of the Palmer Oil Company, Palmer Junior Oil Company and Palmer Senior Oil Company, and owns all the lands formerly held by these companies, and by the Old Mission Oil Company. The well numbers given below are the new numbers of the Palmer Union Oil Company. Nos. 1 to 6 have the old numbers of the Palmer Oil Company, No. 7 was formerly Palmer Junior No. 2; No. 8 was Palmer Junior No. 1, and No. 12 was Palmer Junior No. 3. Nos. 1 to 6 are on Blochman land, the northeast quarter of section 26, 9–33. Later numbers are on the southeast quarter of section 23, 9–33, except No. 11, which is on the northeast quarter of the same section, but close to the quarter line.

Well No. 1 was drilled in 1908, and when first drilled was a pumping well of fair size only. After being on the pump for some months it started to flow without warning, and for a long time thereafter was a most spectacular gusher, producing up to ten thousand barrels per day, actual measurement, of clean oil slightly better than 14° Beaumé. It has now been for some time almost completely sanded up, and though still flowing is doing but a small fraction of its former output. The gravity of the oil is said to have increased somewhat during the last few months, without any change in the rate of flow.

Well No. 2 was drilled in 1909, and had much the same history as No. 1, that is, it came in as a pumper, but later began to flow, and up to a short time ago was a very large producer. It has now been choked, for some four months, and not producing at all, though in January, 1912, it was on the air, and seemed to be picking up a little. The pressure at the bottom of these wells is extremely high, and as the oil is viscous, and is produced from loose sand, it is difficult to keep them in condition unless strongly restrained.

Well No. 3 was finished in 1910, and for a time was a heavy producer, though not approaching either No. 1 or No. 2 in output. It is now completely sanded up, and is being redrilled, the pipe having collapsed.

Well No. 4 is on the west line of the quarter, and about opposite to Dome No. 5. This is a pumping well of fair output, and makes a rather lighter oil than the earlier wells. It also gives much less trouble, and is a reliable producer.

Well No. 5 is in the northwest corner of the quarter, and opposite Dome No. 6. This well has just been completed, January, 1912, and is said to have a very good showing of sand, but is not yet on the production list.

Well No. 6 is on the north line of the quarter, and is a drilling well at 2775 feet (report May 1, 1912).

Well No. 7 is on the south line of section 23, and opposite Palmer Annex No. 2. This well was suspended in the latter part of 1911, and has not been resumed.

Well No. 8 is on the south line of the section, east of No. 7, and near the old location of Old Mission No. 1. This well also has been suspended for some time.

Well No. 9 is on the west line of the tract, opposite Palmer Annex No. 4. This well is suspended.

Well No. 10 is the next location north of No. 9, and is opposite Palmer Annex No. 5. This well is drilling at something over 3000 feet (report May 1, 1912), and is expected to finish within the next 200 feet.

Well No. 11 is the next location north of No. 10, and just north of the center line of the section. This well has been suspended for some time.

Well No. 12 is in the southeast corner of section 23, one location east of No. 8. This well also is suspended. None of these suspended wells are known to have entered the oil sands as yet, but the depths are not known with certainty.

Old Mission Oil Company. The well of this company was near the present location of Palmer Union No. 8. It was drilled in 1908, and was abandoned at about 1100 feet, because of casing trouble.

Associated Oil Company; Lewis. The Associated Oil Company has two wells on the Lewis tract, along the west line of section 25, 9–32. Well No. 1 was drilled in 1910, to a depth reported at 2670 feet. This well had a showing of oil, but so much water that it could not be produced, and it was thought for a time that the limit of the pool had been reached in this direction, as the small quantity of oil made by the well was a very heavy and sticky tar. Later results on neighboring wells have indicated that this well passed through a sand which should probably have been productive, and went into bottom water, which prevented it from making the normal amount of oil. Well No. 2, a short distance north of No. 1, was somewhere about 2200 feet deep, was drilling when last visited, and had a good showing of oil of a gravity normal to the field.

Union Oil Company; Bell. The Union Oil Company has five wells on the Theresa Bell tract, south of the Dome and Palmer Union wells. These wells are all on the south half of section 26, 9–33.

Well No. 1 was drilled in 1909, to a depth approximating 3200 feet. There has been much discussion as to the actual status of this well, and of the adjacent No. 2, but it appears likely that this hole was carried into bottom water, which was shut off by the sanding in of a string of tools in the bottom of the hole. In swabbing the well for the purpose of cleaning out excessive sand, this sand pack appears to have been worked out, and bottom water admitted. The well is said to have

been originally good for some 200 barrels daily, but after the water entered, production fell to a very small figure, and attempts to shut out the bottom water have been but slightly if at all successful. The output of the well is now perhaps a quarter of what it was originally, and carries a large amount of water.

Well No. 2 was drilled in the same year, to a depth of 3060 feet, and is said to have also been carried into a lower water sand. It was then pulled back to 2985 feet and cemented at the bottom, and is reported to have been good for 400 barrels per day after this treatment. The cement plug was accidentally drilled out, and like that of No. 1, the production is now small, and carries much water. Attempts were being made to again shut out the water from this hole, when last visited.

Well No. 3 is some distance to the southwest of the other wells, and was carried to a depth of 4200 feet. Opinions differ as to whether this well encountered any oil, some operators maintaining that it passed through an oil sand at about 2500 feet, then into shale, below which water was found. There are no evidences of oil on or around the rig at present, and the well is suspended.

Well No. 4 was drilled in 1910, to a depth of 2890 feet. This well made a small amount of oil, and much water, and is not now being operated. Here again there is a question as to whether bottom water was entered.

Well No. 5 is on the north line of the southeast quarter of the section, and almost opposite Palmer Union No. 3. This well was finished in 1910, and until lately was considered a moderate pumper. In an effort to increase the output, compressed air was applied to the well during the latter part of 1911, and a large amount of sand raised. When visited, in January, 1912, the air was still on, but so little was entering the tubing that the well might be said to be flowing naturally. At that time it was producing some 3500 barrels daily of clean oil, but has now (May, 1912) been badly sanded, and down to a very small production, for some weeks.

Operating Conditions in Cat Cañon. As already noted, very unusual operating difficulties have been met in the Cat Cañon field as a whole, these falling into two classes, difficulties in drilling, and difficulties in producing. The first are due to the loose and shifting nature of the formations penetrated from the surface down to a depth of perhaps 1000 feet, the second to the very similar structure of the sands from which the oil is raised.

The earlier wells found it extremely difficult to pass a series of loose sands, which repeatedly froze the pipe, and made headway very slow. This trouble was obviated by the invention of the circulating system, now so well known as to need but the briefest description. In general

terms, this consists in passing the drilling line through a packing-head or oil-saver, into which is pumped a steady stream of mud, previously mixed to the consistency of thick cream. This mud passes out of the bottom of the pipe, and flowing up the hole outside the casing, effectively walls up the hole, and seals off the quicksands. This system does away with sand pumping, and while it is rather awkward, because of the necessity of removing the head every time the tools are withdrawn, it fails only in the rare case where a seamy stratum allows the circulating mud to escape into the formation, a very rare occurrence. This system has the same advantage as the rotary, in the ability to pass through quicksand, while unlike the rotary it is not seriously retarded by boulders nor hard shells. Circulation is rarely needed below 1000 feet, in this district, as at this depth the sandy formation is usually passed and more firm shales encountered.

The difficulties met in the endeavor to make these wells produce, and to keep them at it, are much more complex, and are not yet entirely solved. But they are based, apparently, on the same condition of affairs at the producing level as is encountered near the surface.

The oils of Cat Cañon are produced from loose and incoherent sands, of fine texture, and almost entirely free from gravel and grit. Such sands will pack very solidly, if supported, but when saturated with a liquid have a tendency to flow freely when the support is withdrawn, and any slight local disturbance takes place. Further, the oils themselves are quite unusually viscous, and the pressures on the sands are very high. All these conditions, of course, are favorable to choking, packing, or bridging, and to the running of sands into the casing.

In some fields where other conditions are similar, the oil is light and fluid enough to penetrate the interstices between the sand grains, giving a small flow into the perforations of the pipe, which is gradually increased by the washing out of the finer sand particles, thus forming a sort of filter. This filter formation is also favored by the presence in an oil sand of a moderate amount of coarser material, which acts by bridging over the perforations without entirely closing them, and thus holds the finer material back. But in the Cat Cañon field, the oil is so viscous as to pass through the pores in the sand but slowly, thus retarding the formation of a natural filter, and also allowing only a very small infiltration through any sand lying close to the perforations in the pipe.

This, however, does not altogether explain the peculiar behavior of the Cat Cañon wells. These wells do not, like some of the gushers of Midway, fill for hundreds of feet with running sand, nor are the large mounds of sand such as are found around some of the wells at Maricopa, at all in evidence here. The choking which undoubtedly takes place where the oil enters the pipe seems to be outside rather than inside the

casing, and it is probable that the oil-sands themselves are considerably firmer than the running sands of Midway. If this is the case, the choking off of these wells, and the slowness with which they are brought to their maximum production, must be due to a pack of fine sand immediately around the perforations, rather than to the running in of the entire mass from which the oil is drawn. This small pack once taken out, a cavity is left around the perforations, into which oil will drain with a rapidity depending on the viscosity of the oil, the fineness of the sand, and the pressure of gas, and as the latter seems to be ample in all cases, the well will flow as long as this cavity can be maintained. But when, through over-rapid production or disturbance in the formation, the walls of this cavity are broken down, the pack around the perforations again forms, and a long period of very slow production must ensue before a new cavity or filter can be formed, and the solidity of its walls reëstablished.

This is, indeed, the same condition found in any field where oil is produced from loose sand under considerable pressure, and the extreme slowness with which maximum production is gained, or regained when once lost, seems to be due entirely to the unusual viscosity of the oil, and the slowness with which it will penetrate the sand immediately around the perforations, washing out the finer particles and forming a cavity or filter.

Two methods of handling these wells have been tried, each with success but along different lines. The policy of the Dome Oil Company has always been to strongly restrain its wells, pumping them very slowly and raising only clean oil. This plan has resulted in finishing wells with relatively small production, but which can be depended on for a perfectly steady output, and at the smallest expense for maintenance. So that while the maximum production from any well on this lease is far below that of either of the three flowing wells to the east, the gross production of the lease is both satisfactory and profitable, and is steadily, if slowly, increasing.

The policy of the Palmer Oil Company has been exactly the reverse of this—to push its wells to the limit, raising the sand as it came in. This policy has gained the company two very large flowing wells, neither of which has been a steady producer, but each flowing very strongly for periods which have been followed by periods of idleness. As to which method is the more desirable in the long run, the number of experiments is yet too few to determine. The case is of present interest only as indicating the extent to which the output of a well can be controlled by its manipulation after finishing.

Extent of the Cat Cañon Field. The final extent of the Cat Cañon territory has not yet been even suggested, though tentative limits have been set to the southwest, and at the east. At the southwest corner the

two wells of the Union on the Theresa Bell tract (numbers 3 and 4) are not encouraging, though it should be noted that the same conditions which are taken to limit the field at this side were formerly supposed to exist along the west line of section 25, and have since been disproved. But even allowing this, the Las Flores well, about one mile west, has been carried close to the limit of depth (about 4600 feet) and is undoubtedly a dry hole so far, so that the limit to practicable production cannot be very far west of the present producing bounds.

If it is true that the Carpinteria well, at the eastern end of the Cat Cañon group, did not find the same formation as the wells farther west, this would seem to set a limit in this direction, but the fact is not vouched for. No actually dead holes have been drilled in any other direction, except the Associated well on the Williams tract, and it is not at all certain whether, in the light of present information and operating skill, this well might not have been brought to production. On the other hand, no profitable production has yet been had outside of the little group on Blochman land, and the difficulties in the way of producing wells, especially in the cañon itself, are so great that it is by no means certain that this territory will ever be a source of profit.

Prospecting to the East and North. Two wells are now being drilled in what is known as the Tepusquet country, several miles to the north of the Cat Cañon group, but these have not yet reached a depth to demonstrate the prospects for this territory. That the oil measures of the East field do not continue indefinitely to the eastward, is indicated by several wells drilled from three to five miles beyond the Carpinteria location. The records of these holes are as follows:

Princess Oil Company; Tunnell. On the Tunnell tract, the southeast quarter of the southwest quarter, section 3, 9–32, the Princess Oil Company is drilling at about 2500 feet (May, 1912). Some gas is reported, but no oil to this depth.

Santa Maria Midway Oil Company. The well of this company is located on the northwest quarter of the southeast quarter, section 9, 9–32. It is now drilling at some 3200 feet, with a showing of gas and some oil reported (May, 1912). Some distance up the hole a stringer of heavy and viscous tar was encountered.

Kernel Oil Company. This company drilled in the year 1909, on the Rancho Sisquoc, in the southwest quarter of section 13, 9–32. This well was abandoned at 1200 feet, without any indications of oil, which would hardly have been expected at this slight depth. A new well is said to be drilled (May, 1912), just west of the old location.

General Oil Company. This company drilled in the year 1910, on the Rancho Sisquoc, northwest quarter of section 26, 9–32. At the depth

of 2690 feet it entered flowing sulfur water, having a temperature of about 140° Fahr., and for some time flowed about ten feet over the top of a 10-inch casing. This large flow lasted but a short time, but the well still made so much water that it was pulled and abandoned. No oil was found.

Commercial Union Oil Company. A well on the Muscio tract, Rancho Tinaquaic, in the northwest quarter of section 6, 8–31. This well was drilled in 1901, and is said to have entered hard rock. The depth was about 1400 feet, and no oil was found.

Foxen Oil Company. This well was on the Foxen tract of the Rancho Tinaquaic, in the northeast corner of section 1, 8–32. It was drilled in 1909 to a depth of 2657 feet, and found gas and a good showing of oil, but had so much water that it was finally abandoned. This water occurred in several streaks, each carrying a different quality of water.

Dome Oil Company; Tognazinni. The Dome Oil Company drilled a well on the Tognazinni tract of the Rancho Tinaquaic, on the southwest quarter of section 35, 9–32, in the year 1910. This well was carried to a depth of about 1800 feet, and was in brown shale almost all the way, finding a little gas and traces only of tar, but no oil.

QUALITY OF CAT CAÑON OIL.

As shown by the following analyses, all the oils of Cat Cañon are very heavy, ranging from 11.0° to 15.5° Beaumé. As the viscosities of these oils are high even for the gravity, the heaviest grades are almost solid when chilled, and without doubt these are the most viscous oils commercially produced in California, not even excepting the heavier grades of Salt Lake oil.

These oils resemble the crudes of Salt Lake in giving a yield of kerosene which, while not large as a rule, is surprising considering the low gravity. The yield of asphalt is very high. The lubricating stock is usually of fair to good quality, and of low cold test.

The sulfur content of these oils is most surprising, far exceeding that of any other oil found in California. Some samples show over 6 per cent by weight, while 5 per cent is not uncommon. It will be noted that the Salt Lake oils, which show the same general characteristics as these crudes, also run very high in sulfur, and it is very likely, if not certain, that the high yields of asphalt and light distillate are, in both cases, due to the excess of sulfur.

As the Cat Cañon crudes are all very similar, and as the small analyses give but little information as to their properties, it is not considered worth while to quote a larger number of analyses.

4472.*

Brooks Oil Company. Well No. 1.

Gravity ---------- 11.0° Beaumé

This is an extremely viscous, brownish-black oil, with a mild, sweet odor suggesting that of molasses.

Distillation.

Sample of 150 c.c. distilled from copper, in a current of gas. Distillation carried to a residue of dry coke.

First cut	8.0 per cent	44.2° Beaumé
Second cut	10.7 per cent	32.8°
Third cut	68.7 per cent	23.2°
Fixed carbon	12.6 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	9.0 per cent
Stove oil	33°	8.7 per cent
Fuel distillate	30.5°	22.9 per cent } Slop distillate
Reduced stock	15.4°	27.9 per cent } 23.2°—50.8%
Asphalt	"D"	31.5 per cent, or 110.6 lbs. per bbl.
		100.0 per cent

The kerosene from this crude runs a little dark, but treats out to water-white with the test acid. The stove oil after treatment has a rather sharp odor.

The heavy distillate has a good green color, and gives a reduced stock of medium color and good viscosity. This treats out to an 18.1° red oil of viscosity rather low for the gravity, of good color, and free from paraffin.

5449.†

Dome Oil Company. Well No. B 2.

Gravity ---------- 15.5° Beaumé

This is a moderately viscous oil of a brownish-black color, and a mild, sweet odor.

Distillation.

Sample of 150 c.c. distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	8.3 per cent	40.8° Beaumé
Second cut	13.0 per cent	33.5°
Third cut	65.6 per cent	22.8°
Fixed carbon	13.1 grams per 100 c.c.	
	100.0 per cent	

*Analysis by J. P. P.
†Analysis by P. W. P.

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, the following commercial analysis is had:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	7.0 per cent
Stove oil	33°	14.5 per cent
Fuel distillate	30.4°	18.3 per cent / Slop distillate
Reduced stock	16.6°	27.4 per cent \ 22.8°—45.7%
Asphalt	"D"	32.8 per cent, or 115.1 lbs. per bbl.
		100.0 per cent

The light products from this oil ran rather dark from the still, but treated out pale and sweet. The heavy stock was unusually clear and pale, with a mild odor and rather low viscosity—this oil showed a trace of paraffin. The reduced stock had a moderate viscosity and normal color, and treated out to a fine, pale engine oil of 18.4° Beaumé, normal viscosity, but with a cold test of about 60° F.

5454.*

Palmer Oil Company. Well No. 1.

Gravity ---------- 14.4° Beaumé

This is a viscous oil of a brownish-black color and a sweet odor.

Distillation.

A sample of 200 c.c. distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to dry coke.

First cut	14.2 per cent	40.9° Beaumé
Second cut	18.1 per cent	28.0°
Third cut	32.1 per cent	25.1°
Fourth cut	22.5 per cent	23.3°
Fixed carbon	13.1 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of gas, and calculation of the coke to asphalt, the commercial analysis is as follows:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	8.0 per cent
Stove oil	33°	24.0 per cent
Fuel distillate	29.5°	18.3 per cent \ Slop distillate
Reduced stock	15.9°	16.9 per cent / 24.2°—35.2%
Asphalt	"D"	32.8 per cent, or 115.1 lbs. per bbl.
		100.0 per cent

The light products from this oil were yellow, and with a sulfurous odor, but treated out fairly well with the test acid. The heavy distillate was pale, with normal viscosity and a sulfurous odor. This gave a reduced stock which froze solid at about 60° F., and which treated out to a red oil of 17.0° Beaumé, of very fine color, but also solidifying above 60° F.

*Analysis by P. W. P.

5456.*

Palmer Oil Company. Well No. 3.

Gravity ---------- 14.7° Beaumé

This is a viscous oil of a brownish-black color, and a mild, sweet odor.

Distillation.

Sample of 150 c.c. distilled from copper, first two cuts dry, last cut in a current of gas. Distillation to residue of dry coke.

First cut	15.7 per cent	42.0° Beaumé
Second cut	9.4 per cent	30.8°
Third cut	63.1 per cent	27.8°
Fixed carbon	11.8 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a current of gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	15.7 per cent
Stove oil	33°	7.5 per cent
Fuel distillate	29.2°	18.0 per cent) Slop distillate
Reduced stock	16.0°	29.3 per cent) 27.8°—47.3%
Asphalt	"D"	29.5 per cent, or 103.5 lbs. per bbl.
		100.0 per cent

The light products from this oil were yellow, and had a peculiar odor which treatment did not remove. The heavy distillate was of good color, mild odor and rather low viscosity. This gave a rather viscous reduced stock, which treated out to an 18.1° red oil of fine color, and normal viscosity, solidifying at 50° F.

*Analysis by P. W. P.

6469.*

Brooks Oil Company. Well No. 2.

Gravity ..... 10.3° Beaumé

This is a very thick and heavy oil (see table of viscosities), of a black color, with a brownish tinge, and having a mild odor. The sample was taken in January, 1912, and contained much free water, which had not separated appreciably in August of the same year, at laboratory temperature.

Distillation.

Sample of 200 c.c. distilled from copper, using fractionated gasoline to prevent frothing. Last cuts in gas as usual, and distillation carried to dry coke.

First cut	6.0 per cent	38.7° Beaumé
Second cut	16.7 per cent	32.3°
Third cut	56.7 per cent	19.1°
Fixed carbon	20.6 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in a stream of inert gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	3.0 per cent (about)
Stove oil	33°	19.7 per cent
Fuel distillate	29.8°	14.2 per cent } Slop distillate
Reduced stock	14.3°	11.6 per cent } 19.1°—25.8%
Asphalt	"D"	51.5 per cent
		100.0 per cent

The first cut from this crude was fairly sweet and pale, but the stove oil was considerably burned, and very strong with H_2S. The reduced stock was of fair viscosity only, in spite of the very low gravity, but of good color, and apparently of good quality.

*Analysis by J. P. P.

CHAPTER XXI.

SANTA BARBARA COAST.

The coast line of Santa Barbara County, from Naples to the eastern boundary, is followed by a line of heavy oil seepages which have been the incentive to a large amount of drilling. This work has, up to the present, brought no result beyond the development of the little pool at Summerland, and is now almost, or entirely suspended.

These seepages occur both on shore, close to the water's edge, and (apparently, at least) under the shallow waters of Santa Barbara Channel. It is needless to say that the offshore seepages, if such there be, have never been seen, but an oily scum is often visible on the water between Santa Cruz Island and Santa Barbara, and masses of tar are sometimes floated to land when the wind sets inshore. Such are the observed phenomena, that it is highly probable that the seepages beneath the channel are of the same nature as those along the coast.

Some of the latter are unusually extensive and productive, and it seems remarkable that after so much prospecting, no results whatever in the way of commercial production should have been had. And it is perhaps still more remarkable that after the drilling of so many wells, some of them quite deep, so little should be known as to the structure of the country penetrated. This condition may be in part explained by the fact that these wells were, in general, drilled along the apparent strike of the formation, and therefore would not give the same information as to structure afforded by a line of wells across the strike. And again, the lack of any indication of uniform structural conditions may be taken as supporting the theory that there is no uniform structure immediately on the line of seepage; in other words, that the seepages occur in a fault zone.

But before mentioning the theories which have been advanced to account for the lack of success in prospecting along these seepages, it will be well to detail the work which has been done, and to point out the evidences of petroleum found at various points.

The southern coastal strip of Santa Barbara County, along which these developments have taken place, is a generally flat plain, varying in width from a few hundred feet to upwards of three miles. The Santa Ynez mountains, lying to the north, are a high and steep ridge, directed from east to west in a straight line. At their foot is generally found a narrow valley, parallel to the ridge, in front of which is a line of much lower and less rugged foothills. The variation in width of the plain is due to the irregular contour of the coast, the line of foothills, though showing two or three small excrescences, being in the main

quite straight. West of Naples the ocean advances to the hills, leaving but a narrow strip of rolling land, and again at Rincon Creek, the eastern boundary of the county, where the plain is terminated so completely that east of this creek the sea washes the base of the main range at many points.

The surface of the plain consists of alluvium, the rolling hills which make up part of the surface being composed of the same material, carved by erosion, and affording but scant clue to the rock structure beneath. The mountains of the Santa Ynez range are composed mainly of hard shale and sandstone, considerably altered, and showing no evidences of petroleum. The foothill line is likewise bare of surface indications, except at the point, north of Serena, where the Occidental wells were drilled.

Opposite the plain, and at a distance of about thirty miles, lies a chain of islands, parallel to the coast, Santa Cruz and Santa Rosa being the most important. The waters of Santa Barbara Channel, between these islands and the mainland, are shallow. The coast of the mainland shows some evidence of a slight and recent elevation, by which the plain, formed in shallow water from the débris brought down by the mountain streams, has been raised to its present level.

Indications of Petroleum.

Commencing at the west, the seepages which have been noted are as follows:

Edwards Ranch. In the southeast corner of the J. Edwards ranch, west of Naples Station, is a group of small heavy oil seepages immediately adjoining the coast. These seepages issue from cracks in the alluvium of which the surface, level at this point, is composed, and consist of a soft tar, hard enough to be rolled into a ball on cool mornings, but flowing freely in the sun. This tar escapes very slowly, and as the adobe soil from which it issues is non-absorbent, and cuts away readily under the action of water, the tar is carried away and no large brea bed has been formed. Some oil is found on the rocks along the shore line, but this appears to come from the seepages on land. This tar, which was found in some quantity in one of the Wiesendanger wells, exactly corresponds to the residue left by the Summerland oils after slow evaporation, and as it issues from the ground is probably much altered from its original condition. Three wells have been drilled on the Edwards ranch, near these seepages (see Sapphire and Wiesendanger wells).

Rutherford Ranch. The west line of the property of Stephen Rutherford cuts through these seepages, and the tar springs on this ranch a part of the same group. Three wells have been drilled on the south-

west corner of the Rutherford tract, near the seepages (see Santa Barbara & Naples Oil & Land Company).

Den Ranch. On the old J. Den property, south of Elwood Station, tar springs have been reported, but were not examined—these are close to the beach, south and a little east of Elwood. Two wells were drilled here (see Den ranch wells).

Mescalitan Island. A slight seepage is reported on the east bank of the slough south of Mescalitan Island, which is southwest of Goleta. A well was drilled here (see Mescalitan Island Oil & Development Company).

J. Moore Ranch. On this property, south of the town of Goleta, is a large deposit of rich and soft bituminous rock (asphaltic sand) from which shipments were made for paving purposes for many years. Analyses of this rock may be found in the report of the State Mineralogist for the year 1887. No seepages proper have been reported from this vicinity.

Santa Barbara. Slight seepages are said to have once been in evidence on the ocean front just west of the city of Santa Barbara. These are not now to be found. At least three wells were drilled here (see Ocean Front Oil Company, Drexel Oil Company and Mesa Development Company).

East of Santa Barbara. Beginning at Summerland, and thence east to Rincon Creek, are a number of seepages immediately along the water's edge. These seeps are usually found in the low banks of sandy clay and conglomerate just above the beach proper, and are all of the same character, giving a heavy, tarry oil, in small quantity. The seepages at Summerland, which were very slight, were farther back from the shore than elsewhere, and the sands at this point were found by working out (south) from these seepages. Sixteen wells were drilled at various points along this line of tar springs, exclusive of those in Summerland proper.

East of Carpinteria, immediately on the coast, at the junction of the Crocker and Higgins ranches, is a small deposit of rich bituminous rock, known as the Las Conchas asphalt mine, which was once worked for asphalt. A short distance to the east, on the Higgins ranch, is a slight seepage of heavy oil, of which there are also some small springs near the mouth of Rincon Creek.

East of Rincon Creek, no seepages have been reported, nor are there any indications of petroleum along the coast between this point and the city of Ventura, if we except the asphalt deposits on the Rincon ranch and at Punta Gorda. It is said, however, that tar is found in the tide wash, at certain seasons, most of the way to Ventura, which would

indicate that the offshore seepages persist farther to the east than those of the coast.

Santa Ynez Mountains. A number of small seepages have been noted in the foothills of the Santa Ynez mountains, between Santa Barbara and Rincon Creek.

Back of Serena there were formerly some slight seeps in the forks of Toro Cañon, where the Occidental wells were drilled. These seepages seem to have dried up, at least they could not be located, but oil is still flowing from the tunnel at this point (see Occidental Mining & Petroleum Company). This oil is of a different appearance and character from that found along the sea shore.

Other seepages are said to have been found in Oil Cañon, Santa Monica Cañon, and (possibly) Arroyo Parida. These have not been examined. All these seepages, differing in this from the springs along the coast, come immediately from the rock in place, and give an oil of lighter weight and color than the coast oil. The geology of this strip along the foothills is given in some detail in Bulletin 321 of the United State Geological Survey.

Wells Between Naples and Santa Barbara.

Sapphire Oil Company. The most westerly well on the strip here described is that of the Sapphire Oil Company, on the John Edwards ranch. This well is located just north of the railroad, near the east line of the ranch, and some two miles west of Naples station. This hole was started in 1909 and carried to a depth of about 2000 feet, getting some tar and colors of heavy oil. The well is still rigged, but it is not known that any work has been done for a year or more.

Wiesendanger, J. Drilled two wells just east of the above location, on the east line of the Edwards tract, in the year 1901. These wells are situated in a flat-bottomed draw just south of the ranch house. Well No. 1 was drilled with a rotary rig to a depth of 600 deep. It found a stratum of heavy oil at the bottom, and was capped. This tarry oil, accompanied by considerable gas, still issues from the casing head when the bleeder is opened. This well comes nearer to being a producer than others in the neighborhood, but the oil is too heavy to pump, and if any production test was ever made the results are not known.

Well No. 2, some three hundred feet farther north, was drilled to a depth of 450 feet, and found a little thick tar only. This well was abandoned when drilled. It is said that both these wells found their oil in cervices, and that no producing sand whatever was encountered.

Santa Barbara & Naples Oil & Land Company. This company drilled three wells on the southwest corner of the Rutherford tract, just north of the railroad. These wells are on the west line of the ranch, and opposite the Wiesendanger wells. Well No. 1 is directly opposite (east

of) Wiesendanger No. 2, and distant some six hundred feet. It was drilled in the year 1900, to a depth of 1100 feet, and is said to have met ten distinct streaks of tar and oil, but not in oil sand—that is, the oil appeared to be, like that near the surface, located in fissures or crevices in shaly material. It is said that the first streaks encountered were of heavy tar, while the lowest was of a liquid oil of some 15° Beaumé. When the casing was pulled from this well, the tar and oil rose to within seventeen feet of the surface, where it remained for a long time, but rose so slowly as to indicate that no great pressure was behind the supply.

Well No. 2 was south of No. 1, close to the railroad embankment, and almost directly opposite Wiesendanger No. 1. This well was drilled to a depth between 600 and 700 feet, and was abandoned on account of the loss of a string of tools. Fresh water rose in this hole almost to the surface, where it now stands. Much gas, which burns with a yellow flame, still bubbles up inside the old conductor, but no oil whatever is reported from this hole.

Well No. 3 is in a straight line with the two former, but north of No. 1, and near the county road. This well is between 500 and 600 feet deep, and is reported to have found no oil, but to have passed through 120 feet of tarry asphalt. This latter statement may well be doubted, but at any rate the viscous and rubbery mass could not be penetrated with the appliances available, and the well was abandoned.

Den Ranch Wells. These two wells were drilled prior to 1900, for parties not now known, and were located on the beach south of Elwood station. They are reported by the contractors to have been about five hundred feet each in depth, in blue shale all the way, with no oil.

Sea Board Consolidated Oil Company—Steele & Thompson. About one mile east of the Den ranch wells is a hole drilled by Steele and Thompson for some company, not certainly known, but probably the Sea Board Consolidated Oil Company of Los Angeles. This well was 800 feet deep, and is reported to have been in blue shale all the way, with no indications of oil.

Associated Oil Company. This well was located on the low bluff between the railroad and the coast, a short distance east of the Steele and Thompson well. It was drilled in 1909, was about 3600 feet deep, was put down with a standard rig, and is said to have been abandoned because of persistent caving at the bottom, impossible to handle at that depth through the small casing.

The log of this well is not available, but it is said that the hole was almost entirely in blue shale, with streaks of tarry asphalt at considerable intervals. As it had six strings of pipe, the last 4 inches, the formation appears to have been difficult to handle, and this well prob-

ably reached as great a depth as could be attained in such material with a standard rig. It is quite certain that this hole did not find any material quantity of oil, nor any real producing formation.

Mescalitan Island Oil & Development Company. The well of this company was drilled in the year 1901, on the edge of the slough east of the island, and close to the ocean. It was abandoned at 1400 feet, for financial reasons. Mr. Frank Churchill, the contractor for the well, reports that it was "mostly in shale, with streaks of almost pure asphaltum, which got thinner (*i. e.*, softer) as we went down."

Ocean Front Oil Company. The well of this company can not now be located exactly, but is close to the point indicated on map. It was drilled in 1900, and is known to have been shallow, but no reliable record of depth nor of results can be found.

Drexel Oil Company. This location again is only approximate, and may be farther to the west than as shown on map. There is an old hole on the east side of Arroyo Burro, close to the ocean, which may be identical. This well was drilled in the year 1901, was 800 feet deep, and found neither oil nor gas.

Mesa Development Company. This well, drilled by Mr. Floyd Hickey, and known locally by his name, is on the mesa west of the city of Santa Barbara, and some distance north of the ocean. It was drilled in 1901, was approximately 600 feet deep, and is said to have been entirely in brown shale, with some traces of oil.

This completes the list, so far as can be learned, of developments west of the city of Santa Barbara. In none of these holes was any oil sand encountered, and while several holes had some oil, the conditions under which it was found do not encourage the hope that the strip along the coast will ever become producing territory.

No prospecting has ever been done back from the coast, though there are some reasons for believing that such work might possibly bring better results. This subject will be reverted to in a later paragraph.

Wells Between Santa Barbara and Rincon Creek.

Between the city of Santa Barbara and the mouth of Rincon Creek, the following wells are known to have been drilled:

Illinois Oil & Asphalt Company. The well of this company was located on the seashore, near the town of Montecito. It was drilled in 1900, and was abandoned at a depth of 600 feet. Watts notes "yellow clay and sand at 200 feet, blue clay and quicksand, with gas, to 260 feet, blue shale to 280 feet (drilling)." The balance of the log is not known, but the hole does not appear to have developed any oil. This is the only well between Santa Barbara and Summerland.

Churchill & Weber (or Nott & Weber). This well was sunk from the end of a 300-foot wharf, extending into the ocean from the beach somewhat west of Loon Point, south of Serena station. At a depth of 550 feet this well found an oil sand of promising appearance, but in trying to enlarge the 4¼-inch hole the tools were lost and never recovered. This well, with more fortunate mechanical conditions, might perhaps have made a producer.

Clark, Stevens & Duncan. These parties drilled a 500-foot well on the beach east of Loon Point. This well is said to have had some showings of oil, in sand, at the 125-foot and 300-foot levels.

Fisher, J. K. Dug a square shaft to a depth of 120 feet, on the beach east of Serena. This shaft ended in seventeen feet of oil sand, too rich to penetrate further, but not productive enough to make a profitable pumping well.

Treadwell, J. B. This well, which was drilled by the oil land department of the Southern Pacific Company, was on the railroad right of way near Serena station. It was drilled in 1899 to a depth of about 500 feet, and is said to have had some showings of oil.

Columbian Oil Asphalt & Refining Company. Well No. 1 of this company was drilled very close to the beach, on the little flat just west of Carpinteria Creek. This hole was drilled in 1901, was 1100 feet deep, and in blue shale all the way, with much water, but no oil whatever.

Well No. 2 was located north of the railroad, and south of the P. C. Higgins ranch house. This hole was drilled in 1902 and 1903, to a depth of 3200 feet. At 1550 feet a seepage was struck, of an oil claimed to be 19.5° Beaumé. This gravity is open to question, but the oil was undoubtedly thinner and lighter than the oils of Summerland. This sand was not tested when first encountered.

At the bottom the well entered a body of tar too soft to drill and too stiff to bale, and months were spent in the endeavor to penetrate this bed, or to make the well produce from it. Failing in both, an attempt was made to pull back to the 1550-foot sand, and in this attempt the hole was lost. So far as can be learned, this well did not touch any producing sands except the thin streak in which the light oil was found, but got its oil in fissures in the shale. The tar brought up from the bottom of the well contained a little water and fine shale, but no sand, and from its behavior in the hole was judged to lie in a solid mass.

Nixon & Bosig. Well No. 1 was midway between the railroad and the county road, due north of the asphalt refinery. It struck the bituminous rock deposit at sixty-five feet, and was carried to a total depth of 189 feet without further result. This well was drilled in 1891.

Well No. 2 was located in the extreme southeast corner of the Crocker tract, on the beach, and just southeast of the bituminous rock quarry. This well found liquid asphalt between 265 feet and 285 feet, at which depth it was abandoned. This tar is still flowing slowly.

Higgins, P. C. Just across the property line, and immediately east of the foregoing, P. C. Higgins dug a shaft to a depth of 350 feet. This shaft found streaks of oil, with gas, all the way down, but no quantity to make a producer. The oil, like that from the Nixon & Bosig well, was very heavy, but the particular flow from which the latter drew its oil was not encountered.

Higgins No. 2 well is a short distance north of the ranch house, near the county road. This well was carried to a depth of 585 feet, in shale all the way. A single stringer of sand, some six inches thick, was met, this sand carrying gas and traces of a rather light oil.

Northern Consolidated Oil Company. This well was a short distance northwest of the foregoing. It passed through a stringer of bituminous rock near the surface, and found nothing below. Drilled in the year 1900, and abandoned at about 250 feet.

Rahn Consolidated Oil Company. This well, located some 300 feet west of the Higgins ranch house, was started in 1909, and suspended at 1300 feet without finding any oil. It is said to have been continued since that time to a depth of some 2100 feet, and has now been abandoned. It does not seem to have found any indications of oil.

Arctic Oil Company. A short distance east of Columbian No. 2 is the old well of the Arctic Oil Company or Pacific Steam Whaling Company. This well was drilled in 1898, was either 1250 or 1350 feet deep, and was abandoned in a solid mass of tar which could not be penetrated.

Heath, J. Drilled a well near the mouth of Rincon Creek, in the year 1900. This well was carried to 520 feet, and is said to have been good for about 1½ barrels of rather light oil at 150 feet, but found nothing below this depth.

Hill, Dr. R. W. The location of this hole is close to that of the Heath well, and it was drilled in the same year. It was abandoned at 229 feet, with a very little heavy tar.

A number of shallow wells drilled for water farther inland found traces of oil and gas, but the records as to these are too vague to be instructive. It will be noted that, except for a couple of wells close to Summerland, the conditions indicated by the results of drilling at this end are about the same as were observed near Naples and Elwood. In both cases the oil was found in crevices rather than in sand, was of a very heavy character, and, most important of all, immediately adjacent wells showed no similarity of structure whatever. These observations

strongly support the belief that the formations into which these wells were drilled are not in place, but are shattered and fissured fault material, through which oil is seeping from a source not yet discovered nor even suggested. It is not likely that any further prospecting will ever be done in the neighborhood of these seepages.

PROBABLE STRUCTURE OF THE COAST STRIP.

As noted in a previous paragraph, the large number of seepages along this shore line, and the entire absence of result from the prospecting which has been done, have led to much discussion as to the actual structure of this strip lying immediately along the shore line. While this question has now but a nominal interest, as bearing on this particular locality, prospecting having ceased without any present likelihood of renewal, yet there is some reason to believe that the conditions noted here obtain also at many other points along the Pacific coast.

On examining the statements in the preceding paragraphs, several general facts may be noted; *first,* the seepages extend in a single nearly straight line for a distance of some thirty miles; *second,* this line coincides exactly with the present shore line, meaning by this the actual beach or a very narrow strip (a few hundred feet wide only) adjacent thereto; *third,* there are some indications that other seepages occur to the south, beneath the waters of the channel, but none whatever are found on the shore side of this beach line, excepting those in the Santa Ynez range, which are in older formation, and have no present bearing; *fourth,* the seepages are not from rocks in place, but occur apparently at random in loose surface materials; *fifth,* the wells drilled along this seepage line show no correspondence whatever in their logs, and appear to be drilled in broken material; *sixth,* the oil from these seepages is of a highly uniform quality, a heavy, thick tar; *seventh,* the wells which have produced oil have found, in almost all cases, the same quality as that coming from the surface seeps, even when found at great depth; and last, none of the wells outside of the Summerland group have found any oil whatever in sand, but always in tarry streaks or masses interspersed in shale beds.

The range and extent of these seepages are sufficient evidence that a very considerable quantity of petroleum either now exists or has formerly existed along this line. Prospecting has always gone on the assumption that the present source of this material is an oil-bearing sand, and that the seepages are from outcrops lightly covered with alluvium. The two possibilities under this view are indicated below.

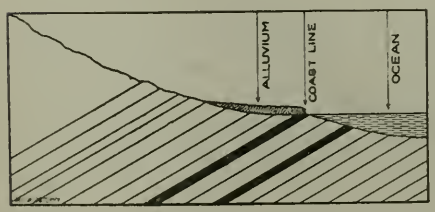


FIGURE 30.

Figure 30 shows the assumed oil sands dipping inshore. This possibility is barred by the results from drilling, as it is clear that if the sands dipped in this direction, a well located even the shortest distance north of the seepage would have encountered the sand at some depth.

Figure 31 shows the assumed oil sands cropping along the shore line, and dipping offshore, as they are known to do at Summerland. This view would account for the lack of results from drilling, as wells located along the shore would be directed away from the sand assumed to crop along this line, though they would have encountered any lower-lying sand. But it entirely fails to explain why the same tarry oil should be found at a great distance below the surface, nor does it recognize the evidently broken character of the formations penetrated along the coast.

FIGURE 31.

Figure 32 shows the oil-bearing formation, assumed to have originally been flat, now raised into an anticline, and faulted along the apex. This view would account for the fault line, and the presence of oil therein, but would make it almost certain that some evidences of oil would be found on the land side of the fault. As a matter of fact, no such evidences have been found.

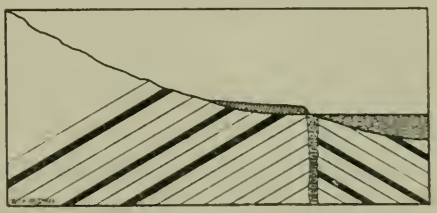


FIGURE 32.

Figure 33 illustrates the theory which, with all the facts in mind, probably comes closest to explaining the actual structure of the formation along this line. In this view, the oil-bearing sands have been faulted off along the shore line, and the land or upthrust side has been sufficiently denuded by erosion to completely remove such portions of the sand as originally lay to this side the fault. It is by no means a violent assumption that the fault and the shore line exactly coincide, for it is quite evident that a continuous uplift on the land side, or what is exactly equivalent, a continuous depression on the ocean side, would locate the shore line immediately in the fault.

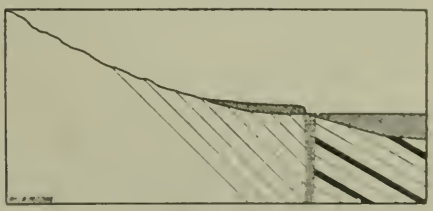


FIGURE 33.

This view seems to account for all the known facts, if we assume that the oceanward portions of the oil-bearing formation have been depressed below the bottom of the deepest wells. This assumption is necessary, as considering the relative weights of water and oil, the latter could not penetrate downward for any distance in fault material saturated with water, but would always rise. This would place the sands assumed to underlie the channel at a great depth below the surface, so that even if the fault plane dipped to the south, and it would be possible to pass through it into the upper edge of the undisturbed formation, the sands which feed the seepages would be far beyond the reach of the drill.

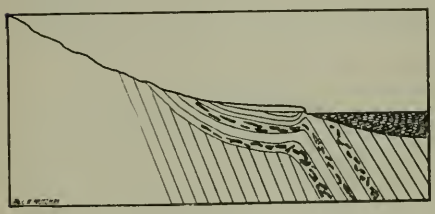


FIGURE 34.

According to this view, the little pool at Summerland (see Figure 34) would be accounted for as a stray sand, originating from oil rising in the fault, and forced back into higher lying sands abutting on the fault. There may be many such pools along the great length of coast showing oil indications, but no means suggests itself by which such pools cool be located, other than by blind prospecting.

Wells in Rincon Creek.

Five wells have been drilled in the cañon of Rincon Creek, back from the coast, all being on the east or Ventura side of the creek. These are as follows:

Channel City Oil Company—Denton Oil Company. Immediately in the creek bed, and some three miles from the ocean, is a group of three wells, of which the first was started by the Channel City Oil Company of Santa Barbara, and finished by the Denton Oil Company of San Francisco.

Well No. 1 was abandoned at 225 feet, on account of casing trouble, and made no discovery.

Well No. 2 is said to have found traces at 800 feet, but with too much water in the hole to permit of testing. It was cementing when last visited, but evidently was not profitable, as it has since been abandoned. A third well is now drilling.

Rincon Oil Company. The first two wells on the Allen tract, now operated by the Rincon Oil Company, are said to have been drilled by previous lessees, whose names cannot now be learned. These wells were drilled into steeply inclined formation showing many hard shells, and were abandoned as crooked holes at 390 feet and 330 feet respectively. When last visited, the Rincon company was drilling its first well, which was then 227 feet deep.

Wells in the Santa Ynez Foothills.

Sycamore Cañon Oil Company. The well of this company was located near the mouth of Sycamore Cañon, on its east side, and but a short distance north of Santa Barbara. This well was drilled in the year 1900, was approximately 800 feet deep, and appears to have been a dry hole. It was abandoned when finished.

Occidental Mining and Petroleum Company. This company had formerly seven wells and one tunnel in the forks of Toro Cañon, about three miles north and one half mile east of the town of Summerland. The records of these wells, which were drilled about the year 1885, are rather scanty, and are given for what they are worth.

Well No. 1 is said to have been 200 feet deep, and to have produced 5000 barrels in all of a heavy brownish oil. Wells No. 2 to No. 4 ranged from 300 feet to 500 feet in depth, and it is not known whether they found any oil, but they were never put to production.

Well No. 5 was approximately 1000 feet deep, and was originally good for about five barrels per day, of the same character of oil. It rapidly fell away, and was pumped but a short time. Wells No. 6 and No. 7 were 350 feet and 500 feet deep, and are said to have made a very small amount of oil. These wells were drilled into a steeply inclined hard shale formation, dipping into the hill, and seeping at the outcrop. The order in which the numbers were arranged is not now known.

The tunnel on this property was started farther down the hill, and was carried into the same formation. It is said to be 511 feet long (Bulletin 321, U. S. G. S.), and is still producing a considerable amount of fresh, sweet water, and a small amount of the oil described below. All the wells on this lease have been abandoned for some years, and the pipe line which formerly carried oil from these wells to the railroad at Serena has been converted into a water line.

Santa Barbara Oil Company. The two wells drilled by this company about the year 1885 are located in Oil Cañon, due east of the Occidental wells, and about three quarters of a mile distant. These wells were between 500 and 600 feet deep, and produced a little oil and much gas.

Carpinteria Oil Company. The two wells of this company are much farther to the south than either of the above locations, being in the lower portion of Arroyo Parida Cañon. Well No. 1 was located on the Bloodgood tract, was drilled in the year 1907, and was abandoned after striking a very little tarry oil, and too much water to handle. The depth of this hole is uncertain, said to be about 1000 feet. Well No. 2 was located on the Barber ranch, was carried to a depth of 1700 feet, and got much salt water but no oil. This company also prospected in Cat Cañon.

Santa Monica Oil Company. The well of this company is about three quarters of a mile northeast of the nearest Carpinteria well, on the

west side of Santa Monica Cañon. It was drilled about the year 1900, was 700 feet deep, and was abandoned on account of water. It is said that at about 400 feet this well found considerable oil of some 18° Beaumé, but that salt water below completely drowned out the oil. It was never produced, so far as can be learned, but was abandoned when completed.

While no valuable production has ever been had from these older formations in the Santa Ynez foothills, it would seem that certain portions of this territory might repay fuller investigation, whenever market conditions will again justify prospecting. All the drilling so far done has been on the outcrops of the producing strata, and while these sands seem to be of no great thickness, and pitch into the hill rather steeply, it is quite possible that operations down the dip, with modern tools and casing, would develop profitable small wells. While there are no indications, either in the rock exposures or in the drilling records, of any likelihood of large production, the country is favorable to operations and close to market, and small wells of a moderate depth would be profitable, even at present prices for crude.

Wells at Summerland.

Summerland, a village of some 250 or 300 people, lies on a mesa, backed by the steep hills of the Santa Ynez range. This mesa slopes gently to the coast, where there is a bluff of some fifty feet in height, with a narrow sandy beach at its foot. The town lies north of the railroad line, which follows the edge of the mesa at a distance of from twenty-five to one hundred and fifty feet.

The first well in the vicinity of Summerland was drilled in the year 1886, by Mr. H. L. Williams. This was located on Ortega Hill, a rounded knoll north of the railroad, at the western end of the town. This well was on the hillside, some two hundred and fifty feet above sea-level, and was carried to a depth of 455 feet, a rich running oil sand being found between 385 feet and 409 feet. Below this came blue clay and shale, and then a second sand, containing lighter oil and in larger quantity—this sand was entered only, and not penetrated. The first well was lost by the parting of the casing, a second was then drilled, but though this also found the oil sand, it proved to be only a small producer, and was abandoned after a short time.

In spite of the fact that these first wells were not a commercial success, the presence of oil had been demonstrated, and developments soon after undertaken to the east of the discovery wells were more successful. The earlier wells were mostly drilled north of the railroad, and these wells were very shallow, from 80 to 150 feet in depth. They were drilled with portable rigs and only the lightest of casing, and while developments were slow at first, in a later period holes were punched down very rapidly, sometimes at the rate of two or three a week.

Wells on Summerland Beach, Santa Barbara County.

Summerland Wells, from K. T. & O. Wharf.

It was soon discovered that the dip of the sands was to the south, that is, toward the ocean, and drilling was rapidly carried in this direction, first across the railroad, then to the beach under the bluff, and finally into the ocean itself. The beach, of course, was government property, and was grabbed by the first comers, so that here there were a large number of very small holdings, as was the case on the land side, where wells were drilled on town lots. At one time there were upwards of one hundred operators in this small field, though this number is now diminished to about a dozen, by abandonment and by consolidation of properties.

The wells to the north of the railroad were soon exhausted, and those farthest north had been pumped out and abandoned some time before the last of the ocean wells was drilled. To both east and west the sands continued, but the productiveness gradually diminished, very gradually at the east, rather abruptly on the west. For this reason the wells farthest east lasted but a short time, while those farthest to the west are still producing in small amounts.

The ocean wells were unique in California, and perhaps in the United States, in being drilled far beyond low tide line, in the open ocean. The wharves started from the bluff, about ten feet above beach level, and were of the lightest piling construction, with only a suggestion of planking. In starting the well, a section of large casing (conductor pipe) was driven into the sand to shut out ocean water, and inside this the well was drilled, the rig being set on temporary planking on the wharf. A single rig sufficed for drilling an entire string, and was then usually left for cleaning purposes, the finished wells being put on the jack.

The longest wharf, 1230 feet, was that of the Southern Pacific Railroad Company, and the wells farthest out on this wharf were at least as productive as those closer to shore, so that development in this direction was not limited by a failure in the productiveness of the sands. But the wharves suffered severely during the winter, and were found difficult to maintain through the stormy period, the wrecking of wharves broke off casings below water level and admitted great quantities of ocean water to the sands, and the production per well was so small that the cost of operation prohibited further extension in this direction, indeed it is very doubtful whether, in most cases, the original cost of these wharves and lines of wells was ever repaid. The drilling of wharf wells therefore ceased about the year 1899, and several of the wharves have entirely disappeared, though on such as remain most of the wells are still being operated.

The depth of the Summerland wells varies considerably, though all are very shallow as compared with the depths reached in other fields. North of the railroad, some of the wells were as little as sixty feet, and

none were over 160 feet. Between the railroad and the beach depths ranged from 150 to 250 feet, while on the beach and the wharves most of the wells were about 250 feet on the land side, deepening to about 450 feet in the wells farthest out. A single well on the Southern Pacific wharf was drilled something over 600 feet, finding gas below the oil sands.

These wells were drilled entirely in soft material—blue shale, clays and sands. In the northern part of the field but a single producing sand was found, though in some of the wells there were several thin sands showing traces of oil. Along the beach, and in the wharf wells, two or sometimes three sands were found. In such cases the heavier oils were found in the upper sands, the middle grade being usually about 1° Beaumé lighter, with a corresponding difference between the middle and the lower sand. As a whole, however, the grade of oil produced was rather uniform, ranging only from 12.5° to 16.5° Beaumé, and all of the same general character, a black oil similar in every respect to that of the Kern River field.

The oil was found in thin strips of loose sand, which in some parts of the field had a strong tendency to run, so that the wells produced considerable sand during the earlier years. As is natural, this tendency was reduced after long pumping, and now but little sand is pumped with the oil. While water was struck in some wells, the field was, in the main, fairly dry for some years. There appears to have been some encroachment of water from the land side, but still more on the side of the ocean, for as wharves were wrecked, many casings were broken off below tide level, admiting great quantities of salt water to the sands. So far as possible these wells have been plugged, but now even the best wells as a rule pump more water than oil. This water separates readily. The oil as pumped goes to a stripping box, which removes most of the sand, as well as the slugs of water. The partly unwatered oil then goes to a tank where it is heated by means of steam coils, and settles clear in a very short time.

The small output of this field has always found a local market, and as a rule at a price materially in advance of that realized over the state at large for the same grade of oil. A refinery which took the bulk of the production was operated here for several years, but was removed some two years ago. Since this time another refinery has been constructed, which now takes perhaps half the output of the field. The balance finds a market in Santa Barbara as fuel, and through the adjacent district for road oiling.

On the land side of the field, the possibility of finding a lower sand at any moderate depth has been clearly disproven. In the cañon east of Ortega Hill, the Crescent Oil Company drilled in 1902, to a depth of 1100 feet without finding any indication of oil. This well went nearly

or quite 1000 feet below the level of the producing sands, which came close to the surface at this point. On the ridge, one quarter mile north of the railroad depot, Darling & Turner drilled a 520-foot well, which showed only traces of oil. On "Town Hill," about 2000 feet northeast of the railroad depot, Williams & Easton drilled a well some 1000 feet deep, which passed through gray and reddish shales, with traces of oil in the shale near the bottom. This well reached a level equivalent to about 1200 feet below the oil sands found lower down the hill. Some of these upper wells showed gas, and for a time the town was in part thus supplied, but the supply failed rapidly. Very little gas accompanied the oil farther down.

To the east the nearest prospect hole was the well noted above, drilled by Churchill & Weber. While this well showed some indications of the producing sands persevering in this direction (along the strike of the formation) the prospects for profitable wells have never seemed to warrant the expense of development. To the south, as mentioned above, the field is limited not by a failure in productiveness of the sands, but by the excessive expense of maintenance of wharf wells. It would therefore seem that there are at present no prospects whatever for an extension of the Summerland pool, unless possibly by the finding of a deeper sand along the beach. The drilling of a deep test hole here has often been discussed, but it has to this time been found impracticable to tie up enough surface to justify the cost of the test.

Statistics. The number of wells in this little pool is so large, and their individual productiveness so small, that a detailed account of operations would be tedious. It will suffice to give a brief résumé of the extent of development at various stages, and of the present condition of the field.

The first recorded production for the field was in the year 1894, when 1800 barrels were produced. The number of wells in operation during that year is not known.

In the year 1895 there were 28 producing wells, all but four of which were north of the railroad. The production for that year was 16,904 barrels, or an average of 1.65 barrels per well per day. This average is quite different from the production estimates given in the reports of that date, which run from 6 to 10 barrels per day, and it is likely that all the wells were not operated for the full year, though even with this allowance, the production of these wells north of the railroad could never have been more than three barrels, daily average.

In 1896 there were 53 producing wells, of which 27 were north of the railroad, and 26 between the railroad and the beach. The production for that year was 39,792 barrels, or an average of 2.06 barrels per well per day.

In 1897 the production of the field went up to 130,136 barrels, in 1898 to 132,217 barrels, and in 1899 to 208,370 barrels. During these years

the development of the field reached its limit, but the number of wells in operation is nowhere recorded.

In June, 1900, Mr. W. L. Watts reports 305 producing wells, 59 abandoned holes, and 15 wells drilling. The production for this year dropped off slightly, to 183,486 barrels. Based on the number of wells in operation at the above date (June, 1900), the average production per well per day in 1899 would be 1.87 barrels, and in 1900, 1.65 barrels. In 1901 the production again rose to 203,616 barrels, but in view of the heavy decline the next year, the figure is open to suspicion. In 1902, the year of the greatest stagnation in the oil market, the output was only 94,550 barrels.

When visited by the writer in December, 1903, a total of 412 wells was found, of which 198 were producing and 100 abandoned, while 114 were rigged for pumping but not then in operation. All the wells north of the railroad were either idle or abandoned at that time, but on the beach and wharves most of the wells were in operation, except at the extreme east, and where wharves had been allowed to go to wreck. The production for the field for this year is given at 131,000 barrels, or an average of 1.82 barrels per well per day.

When visited during the early part of 1910, all the wells north of the railroad had been abandoned. A count of the field showed a total of 440 wells, of which 175 were producing and 265 had been abandoned. Of the producers remaining, 121 were wharf wells, and 54 land wells. No drilling had been done in a long time, except in the way of repairs. Fourteen north and south wharves and three connecting wharves were found, all in a more or less damaged condition. The production for this year was 75,050 barrels, or an average of 1.18 barrels per well per day.

In January, 1912, the same number of wells was found, but the number of producers had shrunk to 133, while a total of 307 had been abandoned. At this time the monthly production was very close to 6,000 barrels, or an average of 1.50 barrels per well per day, the increase in average production being due to systematic cleaning and repairing operations carried out during the last two years, and still under way.

The refinery of the California Liquid Asphalt Company was operated at the western end of the field, close to the Potomoc lease, from 1901 to 1910, at which latter time it was removed to Hadley, San Luis Obispo County. In the succeeding year a refinery was constructed by the B. S. Bennett Refining Company, which is still in operation, making asphalt and heavy distillate. This plant takes perhaps half the output of the field, the balance finding a market in Santa Barbara as fuel, and through the adjacent district for road oiling.

QUALITY OF SUMMERLAND OILS.

The following analyses will show plainly the character of the crude produced from these sands. It will be seen that these oils are normal asphaltic oils, rather low in sulfur, as a rule, and high in asphalt, but otherwise quite similar to Valley oils of equal gravity, and to Los Angeles City oil. Only a few analyses are given, as the range of either gravity or quality is very slight indeed:

6456*

Sunset Oil Company. Average Sample.

Gravity ..... 12.7° Beaumé

This is a thick oil of a black color with a slight brownish shade and with a mild odor.

*Analysis by J. P. P.

Distillation.

A sample of 300 c.c., distilled from copper, first cut dry, second cut in a current of gas. Distillation carried to a residue of dry coke.

First cut	23.6 per cent	33.2° Beaumé
Second cut	65.0 per cent	17.3°
Fixed carbon	11.4 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in gas, and calculation of the coke to asphalt, the following commercial analysis is shown:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	23.6 per cent
Fuel distillate	29.0°	21.1 per cent / Slop distillate
Reduced stock	13.2°	26.8 per cent \ 17.3°—47.9%
Asphalt	"D"	28.5 per cent, or 100.0 lbs. per bbl.
		100.0 per cent

The stove oil from this run was pale and of low bloom, but was very rank with sulfur, and after treatment had still a strong and pungent odor. It was evidently badly decomposed, probably in part at least by the excess of sulfur, which crystallized out in the condenser during distillation.

The lubricating distillate was of a rich color and high viscosity, and the reduced stock also had a high viscosity, but was rather dark. No paraffin shows in the distillate from either this sample or No. 6455.

7406*

Sea Cliff Oil Company. Average Sample.

Gravity	14.9° Beaumé
Viscosity at 185° F.	3.91 Redwood
Sulfur	0.44 per cent by weight
Thermal value	18,626 British thermal units

*Analysis by H. N. Cooper.

Distillation.

A sample of 200 c.c., distilled from glass flask without steam or gas.

Below 392° F.	1.0 per cent	
392 to 482°	10.0 per cent	34.4° Beaumé
482 to 572°	17.4 per cent	28.4°
572° to grade	45.5 per cent	19.8°
Asphalt	23.5 per cent	Grade "D" (about)
Water and loss	2.6 per cent	
	100.0 per cent	

These figures are roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	1.0 per cent (probably)
Stove oil	33°	13.0 per cent
Fuel distillate and lubricants	21.9°	59.9 per cent (not separated)
Asphalt	"D"	23.5 per cent
Water and loss	---	2.6 per cent
		100.0 per cent

6455*

Duquesne Oil Company. Average Sample.

Gravity ---------- 15.1° Beaumé

This is a moderately thick oil, of a brownish-black color, and mild odor.

Distillation.

A sample of 300 c.c., distilled from copper, first cut dry, second cut in a current of gas. Distillation carried to a residue of dry coke.

First cut	17.6 per cent	33.0° Beaumé
Second cut	73.2 per cent	17.7°
Fixed carbon	9.2 grams per 100 c.c.	
	100.0 per cent	

On reduction of the last cut in gas, and calculation of the coke to asphalt, we have the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	17.6 per cent
Fuel distillate	29.0°	18.4 per cent) Slop distillate
Reduced stock	13.8°	41.0 per cent) 17.7°—59.4%
Asphalt	"D"	23.0 per cent, or 80.7 lbs. per bbl.
		100.0 per cent

The stove oil from this crude was pale, with slight bloom, and very sweet. The heavy distillate was also of good color, with a rich green outer tone, and very little burned. The reduced stock was pale and had a slight bluish cast, and only a fair viscosity in spite of the low gravity.

*Analysis by J. P. P.

2498*

Summerland Crude. A mixture.

Gravity ---------- 15.1° Beaumé

Distillation.

A sample of 100 c.c., distilled from a glass flask without steam or gas. Second cut reduced to an 18.0° stock in vacuum. The original runs are:

Crude oil.		
Below 302° F.	None	
302 to 572°	10.0 per cent	35.4° Beaumé
572° to asphalt—a	25.0 per cent	24.3°
572° to asphalt—b	29.8 per cent	22.2°
Asphalt	35.2 grams per 100 c.c.	
	100.0 per cent	
Cuts 2 and 3 from above.		
Fuel distillate	16.4 per cent	33.4° Beaumé
Reduced stock	38.4 per cent	18.0°
	54.8 per cent	

On bringing these figures together, they give the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	None
Stove oil	33°	15.0 per cent
Fuel distillate	33.4°	11.4 per cent
Reduced stock	18.0°	38.4 per cent
Asphalt	"D"	35.2 per cent, or 123.6 lbs. per bbl.
		100.0 per cent

7407.†

Potomoc Oil Company. Well No. Daniels 4.

Gravity ---------- 15.8° Beaumé

Viscosity at 180° F. ---------- 3.20 Redwood

Distillation.

Sample of 200 c.c., distilled from a glass flask without steam or gas.

Below 392° F.	3.0 per cent	43.2° Beaumé
392 to 482°	9.9 per cent	34.0°
482 to 572°	15.4 per cent	27.1°
572° to grade	48.0 per cent	23.1°
Asphalt	22.8 per cent	Grade "D" (about)
Loss	0.9 per cent	
	100.0 per cent	

These figures are equivalent to the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	None
Kerosene	42°	4.0 per cent
Stove oil	33°	9.0 per cent
Fuel distillate and lubricants	24.1°	63.0 per cent (not separated)
Asphalt	"D"	23.0 per cent
Loss	---	1.0 per cent
		100.0 per cent

*Analysis by Wayne Colver.
†Analysis by H. N. Cooper.

ADDITION TO CHAPTER IV.

Quality of the Empire oils.

But three analyses are available of oils from the Empire group of wells, and it is by no means certain that these adequately represent the range of qualities. Some of the wells of this group are reported to produce a much lighter oil, but no samples have ever been obtainable.

These oils, though differing considerably in gravity, are of strikingly similar appearance and behavior. They are much less black than the oils of either Bardsdale or Silverthread, having a strong green tinge which is practically the same in the 24 gravity oil as in that of 35° Beaumé. They are unusually limpid and somewhat more transparent than most of the black oils, and have a mild odor resembling that of finished kerosene.

These oils run high in asphalt for the gravity, and low in middle oils. The lubricating stock cracks considerably, and runs low in viscosity and of a bluish shade. The principal value of these oils is at at the light end, but on the whole they are desirable refining oils for the gravity.

4434*

Empire Oil Company. Wells Nos. 1 and 2.

Gravity ..... 24.6° Beaumé

This is a very limpid oil, of olive-black color and mild rather flat odor.

Distillation.

Sample of 150 c.c., distilled from copper, first three cuts dry, last cut in a current of inert gas. Distillation to dry coke.

First cut	14.8 per cent	51.1° Beaumé
Second cut	10.3 per cent	42.0°
Third cut	16.1 per cent	33.5°
Fourth cut	51.5 per cent	23.6°
Fixed carbon	7.3 grams per 100 c.c. oil.	
	100.0	

The carbon is calculated to the corresponding weight of "D" asphalt by the usual factor, and the last cut reduced in a stream of gas. This gives the following commercial analysis:

Gasoline	61° Beaumé	None
Engine distillate	52°	13 per cent
Kerosene	42°	14 per cent
Stove oil	33°	14 per cent
Fuel distillate	29.2°	13.8 per cent / Slop distillate
Reduced stock	17.3°	26.9 per cent \ 23.6°—40.7°
Asphalt	"D"	18.3 per cent or 64 lbs. per bbl.
		100.0 per cent

The light products from this oil treat only fairly well, giving oils of very mild odor, but not coming to color properly with the test acid.

*Analysis by J. P. P.

The lubricating stock breaks down badly in the crude distillation, and gives a very bluish distillate, which reduces to a stock of the same color. The test acid did not take hold of this stock, and it gave an engine oil of 18.8° gravity, low viscosity, and very dark color.

The yield of engine distillate from this oil is rather surprising, and it is probable that a test of a larger quantity would show some gasoline, though there can not be very much. This analysis is only fair for an oil of this gravity.

7418*

Empire Oil Company. Timber Cañon No. 3.

Gravity ---------- 35.1° Beaumé
Viscosity at 60° Fahr. ---------- 1.66 Redwood (water, 1)
Viscosity at 180° Fahr. ---------- 1.13 Redwood (water, 1)
Flash Point ---------- Below 60° Fahr., Abel–Pensky test

Distillation.

Sample of 200 c.c. distilled from glass, without steam or gas.

Below 212° Fahr.	15.3 per cent	70.0° Beaumé
212 to 302°	15.0 per cent	51.3°
302 to 392°	9.5 per cent	43.2°
392 to 482°	9.5 per cent	38.2°
482 to 572°	9.9 per cent	32.5°
572° to grade	28.0 per cent	27.6°
Asphalt	10.6 per cent	Grade "D" (about)
Loss	1.8 per cent	
	100.0	

This is roughly equivalent to the following commercial analysis:

Gasoline	61° Beaumé	31 per cent
Engine distillate	52°	None
Kerosene	42°	14 per cent
Stove oil	35°	14 per cent
Fuel distillate and lubricants	27.6°	28 per cent not separated.
Asphalt	---	11 per cent
Loss	---	2 per cent
		100 per cent

4431†

Empire Oil Company. Lease Average.

Gravity ---------- 29.4° Beaumé

This is a very limpid oil, of an olive-black color, and mild odor.

Distillation.

Sample of 150 c.c. distilled from copper, first four cuts dry, last cut in a current of gas. Distillation to dryness.

First cut	9.0 per cent	63.0° Beaumé
Second cut	11.0 per cent	52.0°
Third cut	18.0 per cent	41.4°
Fourth cut	8.3 per cent	32.5°
Fifth cut	49.1 per cent	23.0°
Fixed carbon	4.6 grams per 100 c.c. oil.	
	100.0	

*Analysis by H. N. Cooper.
†Analysis by J. P. P.

The carbon is calculated to asphalt by the usual factor, and the last cut reduced in a stream of inert gas, giving the following commercial analysis:

Gasoline	61° Beaumé	12.0 per cent	
Engine distillate	52°	6.0 per cent	
Kerosene	42°	20 per cent	
Stove oil	33°	8 per cent	
Fuel distillate	30.2°	22.5 per cent	Slop distillate
Reduced stock	14.8°	20.0 per cent	23.0°—42.5%
Asphalt	"D"	11.5 per cent or 40 lbs. per bbl.	
		100.0 per cent	

The light products from this oil refine better than those from the heavier crude, giving good colors and odors with the test acid.

The heavy stock breaks badly, and gives distillate with low viscosity, but the reduced stock takes the acid fairly well, giving a red oil of 18.8° Beaumé, with fair red color, good outertone, and medium viscosity. This stock, however, can not be considered of much value, but the light end of the crude shows up well and makes the oil as a whole a good oil for its gravity.

Field.	Wells producing.	Wells abandoned.	Wells drilling.	To date.	BASED ON PRODUCTIVE WELLS ONLY. Estimated acreage productive.[1]	Acres per producing well.	Production, year 1911, barrels, gross.	Product per acre, barrels.	Product per well for year.	Product per well per day.	HEAVIEST CRUDE SAMPLE. Color.	Gravity in degrees Be.	Sulfur per cent by weight.	Gasoline 61 degrees per cent.	Engine distillate 52 degrees per cent.	Kerosene 42 degrees per cent.	Heavy distillate per cent.
Ventura County—																	
Ex-Mission	23	65	1	Mar. 1, 1912	150						Brown-black	14.9		0	0	0	78
Ojai	16	19	2	Mar. 1, 1912	140						Black	11.8	1.5	0	0	0	58
Silverthread	46	15	1	Mar. 1, 1912	440						Brown-black	21.6		0	10	11	66
Santa Paula Canyon	14	20	1	Mar. 1, 1912	60						Black	13.3		0	0	0	
San Cayetano	10	25	1	Mar. 1, 1912	80						Green-black	24.6		0	13	14	55
Sespe-Tar Creek	40	100	13	Mar. 1, 1912	1,060						Black	13.0		0	0	0	
Hopper	18	27	4	Mar. 1, 1912	440						Brownish	14.0		0	0	3	69
Bardsdale	43	19	4	Mar. 1, 1912	240						Black	19.8					
Modelo and Piru	18	22	6	Mar. 1, 1912	80						Black	18.5[1]					
Torrey	48	11	0	Mar. 1, 1912	500						Black	23.9		1	6	20	53
Eureka	11	13	1	Mar. 1, 1912	100						Brown-black	19.8		0	0	18	66
Tapo	5	19	1	Mar. 1, 1912	80						Green-black	21.8		0	0	0	83
Simi	3	10	1	Mar. 1, 1912	160						Black	c16°		[1]			
Calleguas	27	13		Mar. 1, 1912	80						Greenish	c15°		[1]			
Scattering	0	23	1	Mar. 1, 1912													
Totals	322	401	37	Mar. 1, 1912	3,610[1]	11.2	499,082	139	1,550	4.25							
Los Angeles County—																	
Whittier	134	94	16	Mar. 1, 1912	570	4.3	874,519	1,535	6,526	17.88	Brown-black	14.2	0.9	0	0	0	73
Coyote	6	4	6	Mar. 1, 1912	320	53.3	321,004	1,003	53,500	146.58	Brown-black	21.0					
Fullerton	244	57	54	Jan. 1, 1912	1,860	7.6	6,058,034	3,257	24,745	67.99	Black	15.0	1.2	0	0	4	77
Anaheim	3	0	9	Jan. 1, 1912[2]	[1]		300,000		[3]		Black	16.4		0	3	7	62
Puente	53	39	0	Jan. 1, 1912	240	4.5	35,640	148	673	1.85	Brown-black	21.5		0	0	19	62
Los Angeles City	414	900[1]		Jan. 1, 1912	150	0.4	471,096	3,141	1,138	3.12	Black	13.5	1.3	0	0	0	74
Salt Lake and Beverly	258	52	16	Jan. 1, 1912	1,320	5.1	3,404,305	2,303	11,784	32.28	Black	10.0	2.5	0	0	0	53
Newhall	78	139	7	Jan. 1, 1912	540[1]	6.9	150,688	279	1,932	5.29	Black	14.5	0.7	0	0	0	71
Scattering	0	84	3	Jan. 1, 1912													
Totals	1,190	1,369	111		5,000	4.2	11,251,286	2,250	9,455	25.90							
Coast (Santa Barbara)—																	
Santa Maria and Casmalia	201	59	12	Jan. 1, 1912	2,900	14.4	5,670,074[1]	1,955	28,209	77.28	Brownish	20.0	2.1	1	7	10	60
Cat Canyon	12	25	12	Jan. 1, 1912	500	41.7	1,000,000[1]	2,000	83,333	288.30	Black	10.3	6.9	0	0	3	45
Lompoc	37	15	6	Jan. 1, 1912	960	26.0	795,000	828	21,486	58.86	Black	16.2	4.4	1	4	15	57
Summerland[1]	175	265	0	Jan. 1, 1911	50	0.3	71,255	1,425	407	1.10	Black	12.7	1.0	0	0	0	72
Scattering	1	21	2	Jan. 1, 1912													
Totals	426	385	32		4,410	10.4	7,536,329	1,709	17,691	48.47							

ARATIVE TABULATION SHEET.

UDE SAMPLE.					LIGHTEST CRUDE SAMPLE.								
asoline 61 degrees cent.	Engine distillate 52 degrees per cent.	Kerosene 42 degrees per cent.	Heavy distillate per cent.	Asphalt "D" per cent.	Color.	Gravity in degrees Be.	Sulfur per cent by weight.	Gasoline 61 degrees per cent.	Engine distillate 52 degrees per cent.	Kerosene 42 degrees per cent.	Heavy distillate per cent.	Asphalt "D" per cent.	
0	0	0	78	22	Black	27.2	0.7	27	0	13	44	15	
0	0	0	58	42	Black	18.8		0	11	7	59	23	
0	10	11	66	13	Brown-black	27.3		11	13	13	50	13	
0	0	0	100		Black	18.4		0	3	9	88		
0	13	14	55	18	Green-black	35.1[1]		31	0	14	42	11	[1]A lighter oil is reported from this group, but could not be found.
0	0	0	100		Brownish	33.7		20	10	11	44	15	
0	0	3	69	28	Brownish	15.2		0	0	0	85	15	
					Black	27.6	1.7	18	0	17	33	29	
					Green-black	28.4[2]		15	0	26	42	17	[1]No actual production of this grade. [2]A lighter oil, 33° to 35°, lately discovered, no production as yet.
1	6	20	53	20	Black	29.9	0.7	17	0	15	66	17	
0	0	18	66	14	Black	27.4		6	14	24	46	18	
0	0	0	83	17	Black	21.8		4	9	10	54	23	
[1]					Green	c30°		[2]					[1]Similar to Ojai oil—no production. [2]Reported as light, gassy crude—no production.
[1]													[1]Straight lubricating stock; little asphalt; no light products.
													[1]Probably high estimate, wells very much scattered.
0	0	0	73	27	Green black	23.1	0.7	8	5	8	65	14	
					Brownish	30.7		9	5	17	43	26	
0	0	4	77	29	Green-black	34.5	0.4	25	0	27	34	14	
0	3	7	62	28									[1]Insufficient development for estimate. [2]Much new work since this date. [3]Wells brought in during year—no average possible.
0	0	19	62	19	Brown-black	32.5	0.4	15	13	13	46	13	
0	0	0	74	26	Brown-black	17.9	1.0	0	0	0	83	17	[1]Approximate only.
0	0	0	53	47	Black	21.5	2.3	0	15	7	51	27	
0	0	0	71	29	Greenish	38.5	0.3	15	14	18	45	8	[1]Estimate very rough; wells much scattered.
1	7	10	60	22	Brownish	27.6	1.6	16	9	13	48	12	[1]Division Santa Maria (old field) and Cat Canyon; estimate only.
0	0	3	45	52	Black	15.5	4.5	0	0	7	60	33	[1]Mostly gusher production in 1911; average per well in 1912.
1	4	15	57	23									
0	0	0	72	28	Black	15.8	0.9	0	0	4	73	23	[1]All figures for 1910—very little change to 1912.

[1]These figures should be considered comparative only. There is no absolute basis for measurements of productive territory.

INDEX.

Abbott tract, well, 230.
Acquila Oil & Mineral Co., 87.
Adams Cañon wells, 54.
Aetna Oil Co., 158.
Ahnlauf tract wells, 86.
Alamo claim wells, 99.
Alger & Gilmore well, 174.
Alhambra claim wells, 102.
Aliso Cañon wells, 35, 51.
Allen, F. H., wells, 87.
Alliance Oil Co., 176.
Alison & Barlow well, 332.
Alpine Oil Co., 172.
Amalgamated Oil Co., 219, 223, 225.
American Petroleum Co., 224.
Anaconda Oil Co., 101.
Anaheim wells, 274, 277.
Analysis, oil, methods of, 9.
Adams Cañon crude, 65 to 68.
Aloha Oil Co. crude, 120, 121.
Amalgamated Oil Co., Anaheim, 278
Arcturus Oil Co., 237, 239.
Bard Oil & Asphalt Co., 48, 82.
Bardsdale Crude Oil Co., 128.
Bardsdale oils, 128 to 132.
Bastanchury crude, 278.
Big Sespe Oil Co. of Cal., 105.
Birch Oil Co., 311, 319.
Brea Cañon Oil Co., 315, 317.
Brooks Oil Co., 392, 395.
Brownstone Oil & Refg. Co., 114.
Burrows, C. A., 58, 59.
California Oil Co., 109, 110.
Capital Crude Oil Co., 80, 81, 84, 85.
Canadian Queen Oil Co., Tapo, 151.
Castaic crude, 182.
Cat Cañon crude, 392 to 395.
Central claim, Sespe, 110.
Clampitt Bros., Sespe, 109, 110.
Clampitt, E. B., 209.
Clark & Sherman Land Co., 244, 245.
Clark Oil Co., 245.
Columbia Oil Prod. Co., 312.
Connell, D. A., 192.
Cons. Crude Oil Co., 211.
Cosmopolitan Oil Co., 115.
Coyote crude, 278, 279.
Davis & Harrison, 212, 215.
Delaware Union Oil Co., 310.
Dewitt Cañon crude, 188.
Dome Oil Co., Santa Maria, 373.
Dome Oil Co., Blochman, 392.
Doran, Brouse & Price, 211.
Duquesne Oil Co., 414.
East Field crudes (L. A.), 214.
Elsmere crudes, 190 to 193.
Empire Oil Co., 416.
Ex-Mission crudes, 58 to 74.
Eureka Cañon crudes, 147 to 149.
Fidelity Oil Co., 265.
Four Forks crude, 115.
Fullerton Cons. Oil Co., 309, 314.
Fullerton Oil Co., 320, 321.
Gilmore Oil Co., 242.
Graham-Loftus Oil Co., 310, 315.
Grimes tract crudes, 130.
Hall & Hall Oil Co., 368.
Harris (C.C.) Oil Co., 122, 212.
Hawkswing crudes, 112.
Hill tract crude, 351.
Home Oil Co., 262, 266, 267.
Hopper Cañon crudes, 119 to 121.
Industrial Oil Co., 309, 314.
Kentuck crude, 108.
Lewis & Jones Oil Co., 89.
Loma Oil Co., 416.
Los Angeles (Sespe) crude, 113.
Los Angeles city crudes, 207 to 215.
Los Angeles Railway Co., 207.
Midway Petroleum Co., 61.
Modelo Oil Co., 143, 144.
Mud Springs Cañon crudes, 192, 194.
Murphy Oil Co., Coyote, 279.
Murphy Oil Co., Whittier, 267 to 271.
New Penn Petroleum Co., 369, 371.
Nettleton & Kellerman Oil Co., 194.
Newhall Cañon crudes, 189, 191, 192.
Ojai Oil Co., 48.
Pacific Petroleum Co., 240.
Palmer Oil Co., 393, 394.
Park Crude Oil Co., 210.
Parker Oil Co., 208.
Paula Oil Co., 89.
Pearl Oil Co., 191, 192.
Petroleum Devt. Co., 311, 313, 314, 316, 322, 323, 324, 325.
Pico Cañon crudes, 183 to 188.
Pico Oil Co., 318.
Pinal Oil Co., 368, 369, 370, 372.
Pirie tract crude, 33.
Pitcher & Garbutt Oil Co., 242, 244.
Proudfit & Parker, 213.
Potomac Oil Co., 415.
Puente Oil Co., Olinda, 320, 321.
Puente Oil Co., Puente, 287 to 293.
Pyramid Oil Co., 82, 83.
Rancho La Brea Oil Co., 235, 238.
Razzle Dazzle wells, 109, 110.
Rice Ranch Oil Co., 371.
Robertson tract crude, 129.
Rosedale Cemetery crude, 243.
Rose Oil Co., 182.
Salt Lake crudes, 235 to 245.
Salt Lake Oil Co., 236, 240, 241.
Saltmarsh Cañon Oil Co., 62 to 64.
San Cayetano crudes, 416.
Sansinena crude, 309, 310, 318.
Santa Ana Oil Co., 189.

Santa Maria crudes, 368 to 378.
Santa Paula Cañon crudes, 71 to 74.
Sea Cliff Oil Co., 403.
Sespe crudes, 108, 116.
Shirley, I. W., 210.
Slocum Oil Co., 71 to 74.
South Pacific Oil Co., 147 to 149.
Standard Oil Co., Elsmere, 190 to 193.
Pico, 183 to 188.
Wiley, 189.
Star Oil claim crude, 111.
Sulphur Mountain Petroleum Co., 39.
Summerland crudes, 413 to 415.
Sunset Oil Co., Hopper Cañon, 119.
Sunset Oil Co., Summerland, 413.
Tapo Cañon crudes, 150, 151.
Tar Creek crudes, 105 to 107.
Tar Flat crudes, 68 to 70.
Timber Cañon crude, 416.
Torrey crudes, 145, 146.
Treasure Realty Co., 368.
Tunnel Oils, 66, 72.
Turner Oil Co., 263, 264.
Udall claim crude, 115.
Union Oil Co., Adams, 65 to 68.
Bastanchury, 278.
Central, 110.
Four Forks, 115.
Grimes, 130.
Hawkswing, 112.
Hill, 351.
Kentuck, 108.
Los Angeles, 113.
Robertson, 129.
Saltmarsh, 60.
Tapo, 150.
Tar Creek, 105.
Tar Flat, 68 to 70.
Torrey, 145, 146.
Warner Oil Co., 266.
Western Union Oil Co., 373 to 378.
Westlake Oil Co., 207.
Whidden Double Oil Co., 47.
White Star Oil Co., 116.
Whittier Crude Oil Co., 269, 270, 272, 273.
Whittier Fillmore Oil Co., 263.
Wiley Cañon crude, 189.
Zenith Oil Co., 191.
Anchor Petroleum Co., 254.
Angelina Heights well, 329.
Anglo California Oil Syndicate, 349.
Apex Oil Co., 179.
Arcadia claim well, 96, 167.
Arctic Oil Co., 26, 333, 403.
Arcturus Oil Co., 223.
Arizona Oil Co., 93.
Arrellanes tract wells, 365.
Arroyo Burro well, 401.
Arundell, Thos., wells, 52.
Asphalt, by calculation from choke, 16.
Asphalt, by open evaporation, 18.
Asphalt, by vacuum distillation, 18.
Asphaltene, 14.
Associated Oil Co., Arrellanes, 365.
Buell, 345.
California Coast, 360.
Escolle, 365.
Fox, 345.
Lewis, 386.
Lucas, 359.
Newhall, 365.
Pezzoni, 343.
Santa Barbara, 400.
Williams, 381.
Zaca, 345.
(See also Amalgamated Oil Co.)
Atchison, Topeka & Santa Fe R. R. wells, 303.
Atlanta Oil Co., 35, 45.
Azusa wells, 334.

Balboa Oil Co., 235.
Baldwin Ranch well, 258.
Banner Oil Co., 175.
Barca Oil Co., 346.
Bard Oil & Asphalt Co., 44, 46, 78.
Bardsdale wells, 123.
Bardsdale Cañon Oil Co., 126.
Bardsdale Crude Oil Co., 125.
Bardsdale Oil Co., 126.
Bard, T. R., wells, 138.
Bastanchury wells, 276.
Baume, see Beaume.
Bay tract wells, 43, 44.
Bear Cañon well, 178.
Bear Creek Oil & Mining Co., 344.
Belle Vernon Oil Co., 333.
Bell (John) tract wells, 343.
Bell Oil Co., 125.
Bell (Theresa) tract wells, 386.
Belmont claim wells, 159.
Berkeley Oil Co., 136.
Betteravia wells, 342.
Beverly Hills, 196.
Beverly Hills wells, 233.
Big Chief Oil Co., 101.
Big Moses well, 348.
Big Sespe Oil Co, of Ar., 92.
Big Sespe Oil Co. of Cal., 102.
Birch Oil Co., 297.
Bixby Ranch wells, 327.
Black Jack claim wells, 96.
Black Pearl Oil Co., 104.
Blanchard Cañon wells, 135.
Bland well, 197.
Blockman tract wells, 384, 385.
Bookhout tract wells, 124.
Boston Petroleum Co., 180.
Boulder Creek Land & Oil Co., 118.
Boyer, R. M., wells, 54.
Boyle Heights wells, 197.
Boyle & Thompson well, 167.
Bradley Cañon Oil Co., 382.
Bradley Oil Co., 118.
Bradshaw & Beville, 169.
Brashear tract wells, 231.
Brea Cañon oil field, 6, 294, 296.

Brea Cañon Oil Co., 298.
Brea Cañon, see also Fullerton.
Brooks Oil Co., 380.
Brook well, 197.
Brookshire Oil Co., 355.
Brownstone Oil & Refg. Co., 103.
Bryant & Co. well, 320.
Buckhorn Oil & Mining Co., 119.
Buckhorn Oil & Transportation Co., 117.
Buell Ranch Oil Co., 344.
Buena Vista Oil Co., 286.
Bulla tract well, 256.
Bullock tract well, 349.
Burhardt tract well, 234.
Burrows, C. A. & Son wells, 51.
Burson tract wells, 126.
Burton tract well, 346.
Bush, Hoff & Lombard well, 345.

Calabasas Oil Co., 327.
California Coast Oil Co., Drum, 356.
California Coast Oil Co., Hartnell, 360.
California Crude Oil Co., 88.
California Oil Co., Newhall, 170, 172.
California Oil Co., Sespe, 102.
California Star Oil Co., 159.
Calleguas wells, 152.
Calumet Oil Co., 127.
Camarillo Oil Co., see Dolton & Perkins.
Camulos claim wells, 167.
Camulos Oil & Devt. Co., 139.
Canada del Diablo well, 27.
Canada Arena well, 343.
Canada West Oil Co., 43, 46.
Canadian Pacific Oil Co., 255.
Canadian Queen Oil Co., Tapo, 139.
Canadian Queen Oil Co., Ojai, 43, 46.
Cañon claim wells, 118.
Cañon Oil Co., 180.
Capitol Crude Oil Co., 78.
Capitol Crude Oil Co., Climax, 126.
Carbon, determination of, 14.
Carpenter claim well, 96.
Carpinteria Oil Co., Carpinteria, 407.
Carpinteria Oil Co., Cat Cañon, 379.
Carter, B. F., wells, 326.
Casitas Pass well, 26.
Casitas Station well, 33.
Casmalia Petroleum Co., 342.
Casmalia Ranch Oil & Devt. Co., 341.
Castalc Oil Co., 158.
Castalc Oil Association, 158.
Castalc wells, 181.
Cat Cañon oil field, 7, 379.
Cat Cañon Oil Co., 379.
Cates (H.G.) Estate wells, 118.
C. C. Harris Oil Co., see Harris.
Central claim wells, 99.
Central field, Los Angeles, 201.
Central Oil Co., 251, 255, 258.
Central Union Oil Co., Bardsdale, 126.
Central Union Oil Co., Santa Maria, 356.
Central Valley, 1.
Cesapi claim wells, 97.
Chance wells, 330.
Chandler wells, 197.
Chandler Oil Mining Co., 256.
Channel City Oil Co., 406.
Cheseborough & Goldner well, 88.
Chicago Ferndale Oil Co., 87.
Chino wells, 337.
Chino Valley Beet Sugar Co., 338.
Chino Land & Water Co., 338.
Churchill & Weber, 402.
Chicago Petroleum Co., 87.
Chillicothe Oil & Mining Co., 43.
Chismahoo Mountain wells, 26.
Clampitt Bros., Newhall, 172.
Clampitt Bros., Kentuck, 100.
Clampitt Bros., Razzle Dazzle, 102.
Claremont Oil Co., 365.
Clarendon Heights Oil Co., 254.
Clark & Sherman, Towsley, 167.
Clark & Sherman Land Co., 222, 230.
Clark, Stevens & Duncan well, 402.
Climate, Desert Region, 1.
Climate, Central Valley, 2.
Climate, Coast Valleys, 2.
Climate, Pacific Coast, 3.
Climate, Puente Hills, 247.
Climate, Salt Lake oil field, 216.
Climate, Southern California, 1.
Climate, Ventura County, 21.
Climax claim, wells, 126.
Climax Oil Co., 330.
Clyde Jackson Oil Co., 336.
Coast Valleys, 2.
Coast Section, 3.
Coblentz Oil Co., 356.
Coke, calculation to asphalt, 16.
Collins, Isaac, well, 252.
Colonia Oil Co., 137.
Colorado Oil Co., 253.
Colombia Oil Asphalt & Refining Co., 402.
Columbia Oil Producing Co., 300, 306.
Combined Oil Co., 45.
Commercial Oil Co., 172.
Commercial Union Oil Co., 391.
Commonwealth Oil Co., 250.
Compton wells, 332.
Connection claim wells, 97.
Connell, D. A., wells, 174.
Consolidated Midway Chief Oil Co., 167.
Consolidated Petroleum Corporation, 234.
Concord Petroleum Co., 101.
Continental Oil Co., 307
Converse tract wells, 125.
Cooper Oil Co., 88.
Cords well, 338.
Cornerstone Oil Co., 296.
Cosmopolitan Oil Co., 102.
Cottrell dehydration process, 347.
Country Club wells, 234.
Coyote Creek wells, 26.
Coyote Hills Oil Co., 274.
Coyote Hills wells, 274.
Crawford, Henley & Co. wells, 92.
Crescent Oil Co., 410.

Croswell tract wells, 232.
Crown King Oil Co., 136.
Crown of the Valley Oil Co., 297.
Crown Oil Co., 103.
Crude oil analysis, *see* Analysis.
Crude Oil Co., 94.
Cúneo tract wells, 178.

Daisy claim wells, 101.
Davey tract wells, 43.
DeArnaz tract wells, 229, 230.
Delaware Union Oil Co., 299, 302.
Delta claim wells, 102.
Denker, A. H., 234.
Den Ranch wells, 398, 400.
Denton Oil Co., 406.
Denver Oil Co., 179.
Desert Region, 1.
Desoto Oil Co., 197.
Despatch Oil Co., 383.
Development Salt Lake oil field, 226.
DeWitt Cañon wells, 166, 181.
Diblee Ranch wells, 344.
Dickerson tract wells, 141.
Dietz tract wells, 87.
Distillation tests, with gas, 15.
Dividend Oil Co., 170.
Dixie National Oil Co., 103.
Dodson well, 329.
Dollar Oil Co., 333.
Dolton & Perkins, 152.
Dome Oil Co., Blochman, 152.
Dome Oil Co., Lompoc, 349.
Dome Oil Co., Santa Maria, 356.
Dome Oil Co., Tognazinni, 391.
Dome Oil Co., Wickenden, 343.
Double, Edward, well, 42.
Drexel Oil Co., 401.
Drilling Conditions, Cat Cañon, 381, 387.
Drilling Conditions, Lompoc, 350.
Drilling Conditions, Santa Maria, 353.
Drumm tract well, 356.
Drying heavy oils, 301.
Dunkelberger well, 332.

East Cañon wells, 169, 181.
East Field, *see* Cat Cañon and L. A. City.
East Field (Los Ang.), 198.
East Los Angeles wells, 197.
East Piru Oil Co., 158.
East Whittier Oil Co., 258.
Edison Oil Co., 297.
Edwards Ranch wells, 397, 399.
Eefson tract wells, 347.
Egan Ranch wells, 337.
Eldridge, Geo. H. 22, 29, 41.
Elisio tract wells, 51.
Elizalde Oil Co., 342.
Elk Cons. Oil Co., 102.
Elkins claim well, 126.
El Moro Oil Co., 251.
Elsmere Cañon wells, 170, 181.
Empire wells, 50, 88.
Empire Oil Co., 88.
Emslie Oil Co., 103.
Enterprise Oil Co., 176.
Erie Oil Co., 127.
Escolle tract wells, 365.
Esperanza Cons. Oil Co., 348.
Eureka Cañon wells, 133, 137.
Eureka Crude Oil Co., Newhall, 172.
Eureka Oil Co., Ventura, 137.
Eureka Oil Co., Los Angeles, 330.
Ex Mission wells, 50.
Extent Cat Cañon field, 289.

Fairview Cañon well, 119.
Far East Oil Co., 197.
Farrell & Soule wells, 52.
Fay-Granger Co. well, 258.
Federal Oil Co., 348.
Feldt, B. W. well, 56.
Ferndale Oil & Petr. Co., 87.
Fidelity Oil Co., 255.
Fine tract well, 94.
Fisher, J. K., well, 402.
Fisher Oil Co., 277.
  Flagstaff Oil Co., 93.
Flash Tests, 14.
Fleisher Oil Co., 87.
Fleisher tract wells, 381.
Folsom tract wells, 360.
Forest City National Oil Co., 56.
Four Forks claim wells, 99.
Foxen Oil Co., 391.
Fox & O'Boy well, 348.
Fox tract wells, 359.
Freeman & Nelson White Oil Co., 177.
Fryer tract wells, 141.
Fudicker well, 330.
Fugler tract well, 381.
Fullerton Cons. Oil Co., 301.
Fullerton oil field, 6, 294.
Fullerton Oil Co., Whittier, 257.
  Brea Cañon, 297.
  Fullerton, 306.
Fullerton Sunset Oil Co., 338.

Garbutt Oil Co., 224.
Garrett tunnel, 52.
Garvey tract wells, 333.
Gas in Ventura River bed, 33.
Gasson well, 198.
Gasson & Co. well, 330.
Gates Oil Co., 43, 46.
Gay tract well, 232.
Gem Oil Co., 349.
Gillis tract wells, 233.
Gilmore Oil Co., 222.
Gird claim well, 93.
Gird wells, 337, 338.
Globe Oil Co., 338.
Golden Gate Oil Co., Sespe, 103.
Golden Gate Oil Co., Whittier, 258.
Golden West Crude Oil Co., 103, 104.
Golden West Oil Co., Santa Paula, 85.
Golden West Oil Co., Newhall, 175.
Good, F. E., wells, 138.
Good Luck Oil Co., 173.

Graciosa Oil Co., 348, 361.
Grador Oil Co., 225.
Graham-Loftus Oil Co., 299, 302.
Granite, wells in, 177.
Grapevine Cañon Oil Co., 169.
Grapevine Cañon well, 176.
Graves Oil Co., 173.
Gravity, corrections for temperature, 13.
Gravity of oil, *see* Analysis
Grazide tract wells, 285.
Great West Oil Co., 139.
Greenlea Oil Co., 234.
Green Oil Mining Co., 54.
Greve tract wells, 229.
Grimes & Son well, 126.
Grimes Cañon wells, 124, 126.
Grundy Oil Co., 139.
Guiberson tract wells, 127.

Hall & Hall Oil Co., 356.
Hamilton Gardner Oil Co., 57.
Hancock tract wells, 230.
Happy Thought Oil Co., 103.
Hardison & Stewart, DeWitt, 166.
Ex-Mission, 34.
Pico, 159.
Saltmarsh, 52.
Tapo, 138.
Wheeler, 52.
Hardison, Stewart & McFarland, 231.
Harris (C.C.) Oil Co., 117, 118.
Harrison well, 178.
Hart & Hayes well, 258.
Hartford Oil Co., 87.
Hartnell tract well, 360.
Haslam tract well, 349.
Hauser tract well, 232.
Hawkswing claim well, 99.
Headley well, 198.
Heath, J. W., well, 403.
Hedley & Fullerton well, 327.
Henderson Oil Co., 380.
Henderson Union Oil Co., 51.
Hickey well, 501.
Higgins claim wells, 96.
Higgins, P. C., wells, 403.
Hill, R. W., well, 403.
Hillside Crude Oil Co., 77.
Hilltop Oil Co., 77.
Hill tract wells, 348.
Hiss tract wells, 348.
Hoag & Silent well, 198.
Hobson tract well, 28.
Hobbs tract well, 359.
Hogsback claim well, 99.
Hogshead claim well, 99.
Holden, T. D., well, 257.
Holser Cañon wells, 135, 136.
Home Oil Co., 252.
Hook, T. J. well, 93.
Hooper Cañon wells, 91, 117.
Howard Summit wells, 332.
Hunt & Bailey tract well, 251.
Hutton & Co. wells, 134.

Ibex Oil Co., 118.
Ideal Oil Co., 383.
Illinois Oil Co., 257.
Illinois Oil & Asphalt Co., 401.
Income Oil Co., 40.
Industrial Oil Co., 301.
International Oil Co., 276.
Intervenor claim well, 101.
Iola Oil Co., 178.
Iowa Oil Co., 308.
Irelan claim well, 96.
Irwin claim well, 102.
Ivy station well, 233.

Jalama Oil & Devt. Co., 344.
Joe Gilbert claim well, 92.
John Irwin Oil Co., 124.
Johnson well 198, 332.
Joseph claim wells, 103.
Joyce, T. R. wells, 232.
Joyce, Thos., well, 254.
Joyce, E. F., wells, 258.
Junction claim wells, 99.

Kaiser tract wells, 359.
Kansas Crude Oil Co., 234.
Keating tract wells, 233.
Kellerman Oil Co., 336.
Kentuck claim wells, 100.
Kenyon claim well, 99.
Kern Trading & Oil Co., 342.
Kernal Oil Co., 390.

Laguna Beach Oil Co., 337.
Laguna Land Co. well, 342.
Laguna Oil Co., 357.
La Habra Oil Co., 259.
Lancaster wells, 326.
Langdell, Newark & Rowan wells, 34.
Lapp, Gifford Co., wells, 125.
Las Cruces Oil Co., 344.
Las Flores Land and Oil Co., 365.
Leaming Cañon wells, 170, 181.
Leckler Cañon wells, 136, 158.
Leffingwell tract well, 274.
Lewis & Jones Oil Co., 85.
Lewis tract wells, 386.
Liberty Oil Co., 35, 45.
Lighthouse Oil Co., 329.

Limits, Salt Lake oil field, 226.
Little Moore Cañon wells, 166.
Little Sespe wells, 95.
Logs, Pico wells, 159.
Loma Oil Co., 88.
Lombard & Lockhart wells, 229.
Lombart tract wells, 230.
Lompoc Oil Development Co., 349.
Lompoc wells, 345.
Lookout Mountain well, 330.
London Petroleum Co., 172.
Long Beach wells, 329.
Los Alamos Oil & Devt. Co., 348.

Los Alamos Petroleum Co., 383.
Los Angeles City oil field 5, 195.
Los Angeles claim wells, 100.
Los Angeles County wells, 156, 326.
Los Angeles & Kern Oil Mining Co., 177.
Los Angeles Oil Co., 100, 103.
Los Angeles Pacific Ry, Co., 222.
Los Llajas Cañon wells, 142.
Lower Ojai, *see* Ojai.
Lubricants, estimation of, 16, 18.
Lucas tract well, 359.
Lucerne Oil Co., 357.
Lyon Cañon wells, 27, 40.
Lysle tract well, 126.

Maier & Zobelein wells, 331.
Manhattan Beach wells, 327.
Manser tract well, 335.
Mansfield tract well, 232.
Maple Creek claim well, 99.
Massalin tract well, 231.
McCray Bros. Oil Co., 138, 141, 254.
McDor Oil Co., 225.
McGuire tract wells, 139.
McIntosh wells, 330, 332.
McIntyre tract well, 93.
McMillan, W. J., well, 40.
Menges Oil Co., 297.
Menlo claim well, 159.
Mentey well, 176.
Merchants Oil Co., 382.
Merchants & Traders Oil Co., 126.
Meridian Oil Co., 367.
Mesa Development Co., 401.
Mescalitan Island Oil & Devt. Co., 401.
Menges Oil Co., 285.
Methods of analysis, *see* Analysis.
Micaela Oil Co., 344.
Midway Petroleum Co., 53, 54.
Midway Provident Oil Co., 57.
Minnesota claim wells, 125.
Modelo Oil Co., 133.
Mojave well, 327.
Monarch Oil Co., 103.
Montana Oil Co., 103.
Montebello Oil Co., 126.
Montecito well, 401.
Monterey Park Land Co. wells, 333.
Montezuma Oil Co., 179.
Morningside Oil Co., 286.
Morning Star Oil Co., 286.
Moore Ranch, 398.
Mud Springs Cañon wells, 170, 174, 181.
Mulholland Oil Co., 342.
Mupu Oil Co., 88.
Murphy Oil Co., Whittier, 256.
Murphy Oil Co., Coyote, 275.
Muscio tract wells, 343, 391.
Mutual Oil Co., 102, 256.

Naples wells, 397.
Neptune claim wells, 103.
Nettleton & Kellerman Oil Co., 136, 175.
New Castaic Oil Co., 158.
New Century Oil Co., 178.
New England Oil Co., 258.
Newhall Cañon wells, 170, 181.
Newhall Cañon Wells, 170, 181.
Newhall Cons. Oil Co., 179.
Newhall Land & Farming Co., 139.
Newhall Mountain Oil Co., 169.
Newhall oil field 6, 156.
Newhall Petroleum Co., 171.
Newhall, recapitulation, 181.
Newhall tract wells, 365.
Newlove Oil Co., 360.
Newmark & Edwards tract wells, 234.
New Mexico Devt. Co. well, 230.
New Moody Gulch Oil Co., 101.
New Penn Petroleum Co., Fugler, 381.
Kaiser, 357.
Wiley, 357.
Newport Bay Oil Co., 335.
Newport Bay wells, 335.
Newport Oil Co., 336.
New San Pedro Oil Co., 329.
New Weldon Oil Co., *see* Weldon.
Nicholson well, 382.
Nichols tract well, 346.
Niles Lease Oil Co., 224.
Nogales claim well, 101.
Northern Cons. Oil Co., 403.
North of Tar Creek Oil Co., 101.
Northwest Oil Co., 234.
North Whittier Oil Co., 250.
Nott & Webber well, 402.
Nuevo Camulos Oil Co., 136.

Oak Ridge, 123.
Oak Ridge Oil Co., 125.
Occidental Mining & Petr. Co., 407.
Ocean Front Oil Co., 401.
Ocean wells, 409.
O'Hara, Edward, Wells, 85.
Oil analysis, *see* Analysis.
Oil Creek Cons. Oil Co., 102.
Oil Creek Oil Co., 103.
Oil Developments, Southern California, 4.
Oil Fields Syndicate, 343.
Oil King Co., 117.
Oil Spouter claim, wells, 102.
Ojai Oil Co., 40, 43, 44.
Ojai valley, 25.
Ojai Valley Petroleum Co., 42.
Ojai wells, 21, 41.
Okell & Barber well, 331.
Okell Core Drill Co. well, 334.
Old Field, *see* Central field.
Old Field, *see, also,* Santa Maria.
Old Mission Oil Co., 385, 386.
Olga Ventura Oil Co., 40.
Olinda, *see* Fullerton.
Olinda Crude Oil Co., 307.
Olinda Land Co., 307.
Olinda wells, 294, 299.
Oldstead wells, 51.
Omega tract wells, 124, 125.
Operating conditions Cat Cañon, 387.

Orange County Oil Co., 334.
Orange County wells, 326, 334.
Orange Oil Co., 296.
Orcut Oil Co., 347.
Oregon Oil Co., 331.
Oro Water, Light & Power Co. well, 359.
Ortega Hill wells, 408, 410.

Pacific Coast Oil Co., 159.
Pacific Gasoline Co., 298.
Pacific King Oil Co., 179.
Pacific Light & Power Co. wells, 222.
Pacific Petroleum Co., 233.
Pacific Oil Fields, Ltd., 347.
Pacific Oil Transportation Co., 365.
Pacoima Cañon wells, 179.
Pacoima Oil Co., 177.
Padua Oil Co., 176.
Palmer Annex Oil Co., 383, 384.
Palmer Junior Oil Co., 385.
Palmer Union Oil Co., Blochman, 385.
Stendell, 380.
Palomas Cañon well, 158.
Palo Salo Oil Co., 252.
Paula Oil Co., 85.
Paxton Gold Bond Oil Co., 87.
Placerita Cañon wells, 177, 182.
Pearl Oil Co., 170.
Perkins well, 332.
Peter Patterson Oil Co., 125.
Petroleum Devt., Co., 303.
Pezzoni tract well, 343.
Philadelphia-California Petr. Co., 28, 34, 79.
Pickering Land & Water Co. well, 252.
Pico Cañon wells, 159, 181.
Pico wells, tabular list, 160.
Pico Oil Co., 230, 296.
Pierson Hotel well, 328.
Pinal Oil Co., Fleisher, 381.
Santa Maria, 350.
Pine Mountain well, 93.
Pioneer White Oil Co., 178.
Pirie wells, 21, 27, 28.
Piru Oil & Land Co., 135.
Piru Monarch Oil Co., 136.
Pitcher & Garbutt Oil Co., 231.
Pittsburg Petroleum Co., 142.
Point Fermin well, 329.
Pole Cañon well, 103.
Polhemus well, 331.
Port Orange Asphalt Co., 336.
Portland Oil Co., 179.
Primavera Oil Co., 343.
Princess Oil Co., Tunnel, 390.
Princess Oil Co., Muscio, 343.
Production, Tar Creek wells, 98.
Ventura County, 135.
East Field (L. A.), 200.
Central Field (L. A.), 203.
West Field (L. A.), 205.
Salt Lake wells, 228.
Puente wells, 284.
Lompoc wells, 350.
Santa Maria wells, 366.
Proudfit & Parker well, 177.
Puente Crude Oil Co., 300.
Puente Hills wells, 247, 280.
Puente Oil Co., Olinda, 306.
Puente, 280.
Rapetto, 333.
Pumping heavy oil, 221.
Pure Oil Co., 88.
Purisima wells, 347.
Purisima Hills Oil Co., 349.
Puritan Oil Co., 35, 45.
Pyramid Oil Co., 76.

Quality Bardsdale oil, 127.
Cat Cañon oil, 391.
Ex-Mission oil, 57.
Fullerton oil, 308.
Hopper Cañon oil, 119.
Los Angeles City oil, 206.
Newhall oil, 182.
Ojai oil, 46.
Piru Cañon oil, 142.
Puente oil, 287.
Salt Lake oil, 234.
Santa Maria oil, 367.
Sespe oil, 104.
Silverthread oil, 80.
Summerland oil, 413.
Whittier oil, 261.

Radium Oil Co., 358.
Rahn Cons. Oil Co., 403.
Ramona Home Oil Co., 136.
Ramona Oil Co., 136.
Ramera Oil Co., 327.
Rapid Transit well, 198.
Rapetto Hills wells, 333.
Raymond Oil Co., 257.
Razzle Dazzle claim well, 102.
Rancho Canada Miguelito well, 27.
Rancho Canada Larga wells, 34.
Rancho Guadalupe wells, 342.
Rancho Jesus Maria wells, 346.
Rancho Lompoc wells, 348.
Rancho La Brea Oil Co., 217.
Rancho Los Palos Verdes wells, 327.
Rancho Niguel wells, 337.
Rancho Purisima wells, 345.
Rancho Ojai wells, 27, 34.
Rancho Punta Laguna wells, 365.
Rancho Rodeo Aguas wells, 233.
Rancho San Carlos Jonata wells, 344.
Rancho San Joaquin wells, 335.
Rancho Todos Santos wells, 365.
Red Rock Oil Co., 52.
Redondo wells, 327.
Rees well, 198.
Refining & Producing Oil Co., 361.
Rhodes wells, 218.
Rice Cañon Oil Co., 169.
Rice Ranch Oil Co., 358, 383.
Rice well, 181.
Rimpau tract well, 232.
Rinaldi tract well, 176.
Rincon creek wells, 406.

Rincon Oil Co., 406.
Robertson tract wells, 124.
Rob Roy Oil Co., 307.
Rodeo Land & Water Co., 225, 233.
Rodeo Oil Co., 230.
Rommel Oil Co., 232.
Rose Oil Co., 102, 158.
Rosedale Cemetery wells, 232.
Rosemary well, 231.
Rosencranz wells, 332.
Rowland tract wells, 283.
Russian Oil Co., 180.
Rutherford ranch wells, 397, 399.

Safe Oil Co., 171.
Salt Lake Oil Co., 219, 223.
Salt Lake wells, 5, 196, 216.
Saltmarsh Cañon Oil Co., 52.
Sampson claim wells, 101.
Sansinenta tract wells, 299.
Sapphire Oil Co., 399.
Savage tract well, 255.
San Bernardino well, Newhall, 178.
San Bernardino County wells, 326, 337.
San Cayetano Oil Co., 117.
San Juan Capistrano well, 337.
San Juan well, 276.
San Lucas Oil Co., 344.
San Miguel Oil & Devt. Co., 178.
San Pedro Oil Co., 328.
Santa Ana Oil Co., 136, 172, 176, 336.
Santa Barbara, Cal., Oil Co., 344.
Santa Barbara Coast wells, 396.
Santa Barbara County wells, 339.
Santa Barbara & Naples Oil & Land Co., 399.
Santa Barbara Oil Co., 407.
Santa Barbara Oil & Mining Co., 358.
Santa Clara Oil & Devt. Co., 88.
Santa Fe claim well, 101.
Santa Maria Central Oil Co., 358.
Santa Maria Crude Oil Co., 44, 46, 358.
Santa Maria Enterprise Oil Co., 380.
Santa Maria Midway Oil Co., 390.
Santa Maria Oil Fields, Ltd., 384.
Santa Maria Oil & Gas Co., 360.
Santa Maria Petr. & Pipe Line Co., 380.
Santa Maria wells, 352.
Santa Monica Oil Co., 407.
Santa Paula Gravity Oil Co., 88.
Santa Paula Home Oil Co., 125.
Santa Paula Oil Co., 41.
Santa Susuana wells, 124, 125.
Santa Ynez foothill wells, 344.
Santa Ynez wells, 343.
Scarab Oil Co., 141.
Schuyler Ranch well, 334.
Scott & Gilmore wells, 56.
Scott & Loftus wells, 198.
Scott tunnel, 34.
Scott (W.B.) Oil Co., 286.
Seaboard Cons. Oil Co., 400.
Searchlight Oil Co., 93.
Seepages at Carpinteria, 398.
Seepages at Naples, 397.
Sentinel Oil Co., 257.
Sespe Cañon Oil Co., 92.
Sespe Cañon wells, 91.
Sespe Crude Oil Co., 92.
Sexton Cañon wells, 57.
Shafer Oil Co., 276.
Shenandoah claim well, 101.
Sherman Oil Co., 225.
Sherman wells, *see* Salt Lake.
Shiells tract wells, 126.
Sickelworth ranch well, 334.
Sidehill claim well, 99.
Silverthread wells, 50.
Simi Oil Co., 142.
Simi Ranch wells, 159.
Sisar Oil & Asphalt Co., 79.
Sisar wells, 74.
Sisquoc Oil Co., 379.
Sisters' Hospital wells, 331.
Skimming wet wells, 363.
Skookum Oil Co., 103.
Slocum Bros. wells, 56.
Slocum & Co., 134.
Sobra Vista Oil Co., 41.
Soquel Cañon Oil Co., 307.
Southern Pacific wells, 402.
Southland Oil Co., 119.
South Pacific Oil Co., 137.
Spring Valley claim wells, 99.
Squaw flat Oil Co., 101, 172.
Squires tract wells, 360.
Standard Crude Oil Devt. Co., 257.
Standard Oil Co. Elsmere, 173.
Standard Oil Co., Leffingwell, 274.
Standard Oil Co. Rapetto, 333.
Standard Oil Co. Rice, 169.
Standard Oil Co. Toler, 275.
Standard Oil Co. Wiley, 169.
Standard Oil Co., Yriarte, 277.
Standard Oil Co. Pico, 159.
Star Oil claim, wells, 100.
Statistics, Salt Lake wells, 227.
Statistics, Summerland wells, 411.
St. Bernard Oil Co., 168.
Stearns tract wells, 299.
Steele & Thompson well, 400.
Stendell tract wells, 380.
St. Louis Oil Co., 119.
Stockholders Oil Co., 101.
Strong tract wells, 254.
Structure, Central field, 202.
  Coast Strip, 404.
  East Field (L. A.), 199.
  Fullerton field, 295.
  Puente field, 280.
  Salt Lake field, 216.
  Santa Maria field, 353.
  Silverthread group, 79.
  West Field (L. A.), 204.
  Whittier field, 248.
Sudden Oil Co., 346.
Sulfur determination method, 14.

Sulfur in Cat Cañon oil, 391.
Los Angeles oil, 5.
Salt Lake oil, 5.
Santa Maria oil, 7.
Whittier oil, 6.
Sulphur Mountain Petr. Co., 34.
Sulphur Mountain wells, 21.
Summary, Ventura County, 153.
Summerland wells 6, 408.
Summit Oil Co., 382.
Sunset claim wells, 101.
Sunset Oil Co., 117.
Swall tract well, 225.
Swastika Oil Syndicate, 327.
Sycamore Cañon Oil Co., 407.
Syndicate Petroleum Co., 299, 342.

Tapo wells, 133.
Tapo Cañon wells, 138.
Tapo Oil Co., 119, 141.
Tar Creek wells, 95, 98.
Tar Flat wells, 54.
Tar Hole claim wells, 92.
Taylor wells, 28.
Temescal Ranch wells, 133 to 136.
Temperature corrections, 13.
Temple claim wells, 167.
Thanksgiving Oil Co., 51.
The Oil Co., 342.
Thirty Six claim, wells, 92.
Thomas, H. C., well, 232.
Thompson tract wells, 41.
Thompson Bros. well, 331.
Tidewater Oil Co., 336.
Tognazinni tract well, 391.
Toler tract well, 95.
Torrey wells, 133, 140.
Tower tract wells, 78.
Towns well, 337.
Towsley Cañon wells, 167, 181.
Towsley Cañon Oil Co., 168.
Traders Union Oil Co., 342.
Treadwell, J. B., well, 402.
Treasure Realty Co. wells, 356.
Tubbs & Evans well, 254.
Tujunga wells, 179, 182.
Tujunga Oil Co., 180.
Tunnel, Garrett, 52.
Tunnel, oil, 34.
Tunnel oil, character of, 52.
Tunnel, Wheeler, Trask & Coleman, 52.
Tunnel tract well, 390.
Turner Oil Co., 253.
Twilight claim well, 96.

Udall claim wells, 102.
Uncle John Oil Co., 57.
Underhill tract wells, 343.
Union Beet Sugar Co. wells, 342.
Union Cons. Oil Co., 92, 104.
Union Oil Co. of California, 51, 54, 123.
Union Oil Co., Ahnlauf, 86.
Alamo, 99.
Arcadia, 96.
Union Oil Co.—Continued.
Arrellanes, 365.
Bastanchury, 276.
Bell, 386.
Black Jack, 96.
Bookhout, 124.
Brashear, 231.
Burson, 126.
Burton, 346.
California Coast, 360.
Calleguas, 152.
Carpenter, 96.
Central, 99.
Cesapi, 97.
Chino, 338.
Connection, 97.
Dickerson, 141.
Eefson, 347.
Fairview, 119.
Folsom, 360.
Four Oaks, 99.
Fox, 359.
Fryer, 141.
Graham-Loftus, 277.
Grimes, 124.
Gniberson, 127.
Hartnell, 360.
Haslam, 349.
Hawkswing, 99.
Higgins, 96.
Hill, 348.
Hobbs, 359.
Hogsback, 99.
Hogshead, 99.
Irwin, 99, 102.
Irelan, 96.
Junction, 99.
Kaiser, 357, 359.
Kenyon, 99.
Kentuck, 100.
La Habra, 259, 287.
Los Angeles City, 331.
Los Angeles claim, 100.
Maple Creek, 99.
Massalin, 231.
Newlove, 360.
Nichols, 346.
No. 6 lease, 75.
Plrie, 29.
Purisima, 317.
Robertson, 124.
Saltmarsh, 53.
San Juan, 276.
Sansinena, 299.
Santa Susana, 124.
Sespe, 96, 100.
Sidehill, 99.
Silverthread, 76.
Sisar, 75.
Spring Valley, 99.
Squires, 360.
Star Oil, 100.
Stearns, 299.
Tapo, 138.

Union Oil Co.—Continued.
Thirty-six, 92.
Torrey, 140.
Twilight, 96.
Wildcat, 99.
Whittier, 257.
United Oil Co., 119.
United Oil & Mining Co., 135.
United States Hotel well, 331.
Upper Ojai, *see* Ojai.

Variel tract well, 232.
Ventura, California Oil Co., 103.
Ventura claim well, 87.
Ventura Coast Oil Co., 138.
Ventura Cons. Oil Co., 142.
Ventura County, 21.
Ventura Oil Co., 41.
Ventura Oil Devt. Co., 137, 172.
Ventura Oil & Land Co., *see* Ventura Oil Co.
Ventura Co. Power Co. wells, 33.
Ventura Co., summary, 153.
Viscosity tests, 14.
Volcano Oil Co., 328.

Wade, F. S., 14.
Warner Oil Co., 255.
Warring Bros. well, 138.
Washington Oil Co., 167.
W. B. Scott Oil Co., 286.
Webb tract well, 93.
Webfoot Oil Syndicate, 103.
Weisendanger wells, 399.
Weldon Oil Co., 34.
Weldon tract well, 176.
Well records, Puente, 280.
Wells on South Slope, 176.
Wells South of Los Angeles, 331.
Wells North of Los Angeles, 229.
Wells West of Ventura River, 26.
Wells in Ventura River valley, 33.
Wells, Ventura County, 155.
West Coast Oil Co., 233, 255.
Western Avenue wells, 205.
Western Coast Oil Co., 26.
Western Union Oil Co., 362.
West Field (L. A.), 203.
West Huasna Oil Co., 125, 366.
West Lake Rommel Oil Co., 76.
West Oil Co., 381.
Westside claim well, 102.
Wharf wells, 409.
Wheeler Cañon wells, 51.
Wheeler, Trask & Coleman tunnel, 52.
Whidden Double Oil Co., 41.
Whitelaw Oil Co., 141.
White Star Oil Co., 102.
Whiting well, 334.
Whittier Cons. Oil Co., 250.
Whittier Crude Oil Co., 253.
Whittier Des Moines Oil Co., 276.
Whittier Fillmore Oil Co., 104, 253.
Whittier Grande Oil Co., 257.
Whittier Oil & Devt., Co., 258.
Whittier wells 5, 248.
Whittier Oil Co., 254.
Whittier Producers Oil Co., 258.
Whittier, recapitulation, 259.
Whitworth tract wells, 229, 230.
Wicks well, 229.
Wild Bill well, 55.
Wildcat claim wells, 99, 102.
Wiley Cañon wells, 168, 181.
Wiley tract well, 357.
Wilkinson well, 198.
Williams well, 408.
Williams tract well, 381.
Wilmot & Holden well, 331.
Wilshire Boulevard wells, 228.
Wilson tract wells, 119.
Wickenden tract well, 343.
Wise & Denigan wells, 347.
Wolfskill tract wells, 233.
Wood well, 125.
Woods well, 87.

Yankee Doodle Oil Co., 176.
Yriarte tract well, 277.

Zaca station well, 345.
Zenith Oil Co., 171.

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

REPORTS.

Asterisk (*) indicates the publication is out of print.

				Price.	Postage.
*Report	I.	Henry G. Hanks.	1880.		
*Report	II.	Henry G. Hanks.	1882.		
*Report	III.	Henry G. Hanks.	1883.		
*Report	IV.	Henry G. Hanks.	1884.		
*Report	V.	Henry G. Hanks.	1885.		
*Report	VI—Part 1.	Henry G. Hanks.	1886.		
*Report	VI—Part 2.	Wm. Irelan, Jr.	1886.		
*Report	VII.	Wm. Irelan, Jr.	1887.		
*Report	VIII.	Wm. Irelan, Jr.	1888.		
*Report	IX.	Wm. Irelan, Jr.	1889.		
*Report	X.	Wm. Irelan, Jr.	1890.		
Report	XI.	Wm. Irelan, Jr.	1892. (First biennial.)	$1.00	$.15
*Report	XII.	J. J. Crawford.	1894. (Second biennial.)		
*Report	XIII.	J. J. Crawford.	1896. (Third biennial.)	1.00	.20

BULLETINS.

			Price.	Postage.
*Bulletin	1.	Dessicated Human Remains.—Winslow Anderson. 1888		
*Bulletin	2.	Methods of Mine Timbering.—W. H. Storms. 1894		
*Bulletin	3.	Gas and Petroleum Yielding Formations of the Central Valley of California.—W. L. Watts. 1894		
*Bulletin	4.	Catalogue of California Fossils (Parts 2, 3, 4 and 5.)—J. G. Cooper. 1894		
*Bulletin	5.	The Cyanide Process: Its Practical Application and Economical Results.—A. Scheidel. 1894		
Bulletin	6.	California Gold Mill Practices. E. B. Preston. 1895	$.50	$.04
*Bulletin	7.	Mineral Production of California, by Counties, 1894.—Chas. G. Yale. (Tabulated sheet)		
*Bulletin	8.	Mineral Production of California, by Counties, 1895.—Chas. G. Yale. (Tabulated sheet)		
Bulletin	9.	Mine Drainage, Pumps, etc.—Hans C. Behr. 1896	.60	.08
*Bulletin	10.	A Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California.—A. W. Vodges. 1896		
*Bulletin	11.	Oil and Gas Yielding Formations of Los Angeles, Ventura, and Santa Barbara Counties.—W. L. Watts. 1896		
*Bulletin	12.	Mineral Production of California, by Counties, 1896.—Chas. G. Yale. (Tabulated sheet)		
*Bulletin	13.	Mineral Production of California, by Counties, 1897.—Chas. G. Yale. (Tabulated sheet)		
*Bulletin	14.	Mineral Production of California, by Counties, 1898.—Chas. G. Yale. (Tabulated sheet)		
Bulletin	15.	Map of Oil City Oil Fields, Fresno County.—J. H. Means	.05	.02
*Bulletin	16.	The Genesis of Petroleum and Asphaltum in California.—A. S. Cooper. 1899		
*Bulletin	17.	Mineral Production of California, by Counties, 1899.—Chas. G. Yale. (Tabulated sheet)		
*Bulletin	18.	The Mother Lode Region of California.—W. H. Storms. 1900		
*Bulletin	19.	Oil and Gas Yielding Formations of California.—W. L. Watts, 1900.		
*Bulletin	20.	Synopsis of Reports of State Mining Bureau.—W. L. Watts. 1900		
*Bulletin	21.	Mineral Production of California, by Counties, 1900.—Chas. G. Yale. (Tabulated sheet)		
*Bulletin	22.	Mineral Production of California for Fourteen Years.—Chas. G. Yale. 1900. (Tabulated sheet)		
Bulletin.		Reconnaissance of the Colorado Desert Mining District.—Stephen Bowers. 1901		.02
Bulletin	23.	The Copper Resources of California.—P. C. DuBois, F. M. Anderson, J. H. Tibbits, and G. A. Tweedy. 1902	.50	.12
*Bulletin	24.	The Saline Deposits of California.—G. E. Bailey. 1902		
*Bulletin	25.	Mineral Production of California, by Counties, 1901.—Chas. G. Yale. (Tabulated sheet)		
*Bulletin	26.	Mineral Production of California for Fifteen Years.—Chas. G. Yale. 1901. (Tabulated sheet)		
Bulletin	27.	The Quicksilver Resources of California.—Wm. Forstner. 1903	.75	.14
*Bulletin	28.	Mineral Production of California, by Counties, 1902.—Chas. G. Yale. (Tabulated sheet)		

Asterisk (*) indicates the publication is out of print.

		Price.	Postage.
*Bulletin 29.	Mineral Production of California for Sixteen Years.—Chas. G. Yale. 1902. (Tabulated sheet)	----	----
*Bulletin 30.	A Bibliography of Geology, Palæontology, and Mineral Resources of California.—A. W. Vodges. 1903	----	----
Bulletin 31.	Chemical Analyses of California Petroleum.—H. N. Cooper. 1903. (Tabulated sheet)	----	$.02
Bulletin 32.	Production and Use of Petroleum in California.—P. W. Prutzman. 1904	$.25	.08
*Bulletin 33.	Mineral Production of California, by Counties, 1903.—Chas. G. Yale. (Tabulated sheet)	----	----
*Bulletin 34.	Mineral Production of California for Seventeen Years.—Chas. G. Yale. 1903. (Tabulated sheet)	----	----
*Bulletin 35.	Mines and Minerals of California for 1903.—Chas. G. Yale. 1904. (Statistical)	----	----
*Bulletin 36.	Gold Dredging in California.—J. E. Doolittle. 1905	----	----
Bulletin 37.	Gems, Jewelers' Materials, and Ornamental Stones of California.—George F. Kunz. 1905:		
	First edition (without colored plates)	.25	.08
	Second edition (with colored plates)	.50	.08
*Bulletin 38.	The Structural and Industrial Materials of California.—Wm. Forstner, T. C. Hopkins, C. Naramore, L. H. Eddy. 1906	----	----
*Bulletin 39.	Mineral Production of California, by Counties, 1904.—Chas. G. Yale. (Tabulated sheet)	----	----
*Bulletin 40.	Mineral Production of California for Eighteen Years.—Chas. G. Yale. 1904. (Tabulated sheet)	----	----
*Bulletin 41.	Mines and Minerals of California for 1904.—Chas. G. Yale. (Statistical)	----	----
*Bulletin 42.	Mineral Production of California, by Counties, 1905.—Chas. G. Yale. (Tabulated sheet)	----	----
*Bulletin 43.	Mineral Production of California for Nineteen Years.—Chas. G. Yale. 1905. (Tabulated sheet)	----	----
*Bulletin 44.	Mines and Minerals of California for 1905.—Chas. G. Yale. (Statistical)	----	----
*Bulletin 45.	Auriferous Black Sands of California.—J. A. Edman. 1907	----	----
Bulletin 46.	General Index to Publications of the State Mining Bureau.—Compiled by Chas. G. Yale. 1907	.30	.06
*Bulletin 47.	Mineral Production of California, by Counties, 1906.—Chas. G. Yale. (Tabulated sheet)	----	----
*Bulletin 48.	Mineral Production of California for Twenty Years.—Chas. G. Yale. 1906. (Tabulated sheet)	----	----
*Bulletin 49.	Mines and Minerals of California for 1906.—Chas. G. Yale. (Statistical)	----	----
Bulletin 50.	The Copper Resources of California.—A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne, J. A. Edman. 1908	1.00	.20
*Bulletin 51.	Mineral Production of California, by Counties, 1907.—D. H. Walker, Statistician. (Tabulated sheet)	----	----
*Bulletin 52.	Mineral Production of California for Twenty-one Years.—D. H. Walker, Statistician. 1907. (Tabulated sheet)	----	----
*Bulletin 53.	Mineral Productions of California for 1907, with County Maps.—D. H. Walker, Statistician. 1908. (Statistical)	----	----
*Bulletin 54.	Mineral Production of California, by Counties, 1908.—D. H. Walker, Statistician. (Tabulated sheet)	----	----
*Bulletin 55.	Mineral Production of California for Twenty-two Years.—D. H. Walker, Statistician. 1908. (Tabulated sheet)	----	----
*Bulletin 56.	Mineral Productions for 1908, County Maps, and Mining Laws of California.—D. H. Walker. 1909. (Statistical)	----	----
Bulletin 57.	Gold Dredging in California.—W. B. Winston, Charles Janin. 1910	1.50	.15
*Bulletin 58.	Mineral Production of California, by Counties, 1909.—D. H. Walker, Statistician. (Tabulated sheet)	----	----
*Bulletin 59.	Mineral Production of California for Twenty-three Years.—D. H. Walker, Statistician. 1909. (Tabulated sheet)	----	----
*Bulletin 60.	Mineral Productions for 1909, County Maps, and Mining Laws of California.—D. H. Walker. 1910. (Statistical)	----	----
Bulletin 61.	Mineral Production of California by Counties for 1910.—D. H. Walker, Statistician. (Tabulated sheet)	----	.02
Bulletin 62.	Mineral Production of California for Twenty-four Years.—D. H. Walker, Statistician. 1910. (Tabulated sheet)	----	.02
Bulletin 63.	Petroleum Development in Southern California.—P. W. Prutzman. 1912	----	----
Bulletin 64.	Mineral Production for 1911.—E. S. Boalich, Statistician, 1912	----	----

PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU—Continued.

Asterisk (*) indicates the publication is out of print.

REGISTERS OF MINES WITH MAPS.

	Price.	Postage.
Amador County	$.25	$.08
Butte County	.25	.08
*Calaveras County	----	----
*El Dorado County	----	----
*Inyo County	----	----
*Kern County	----	----
Lake County	.25	.08
Mariposa County	.25	.08
Nevada County	.25	.08
*Placer County	----	----
*Plumas County	----	----
*San Bernardino County	----	----
San Diego County	.25	.08
Santa Barbara County	.25	.08
*Shasta County	----	----
*Sierra County	----	----
*Siskiyou County	----	----
*Trinity County	----	----
Tuolumne County	.25	.08
Yuba County	.25	.08
Register of Oil Wells (with map), Los Angeles City	.35	.02

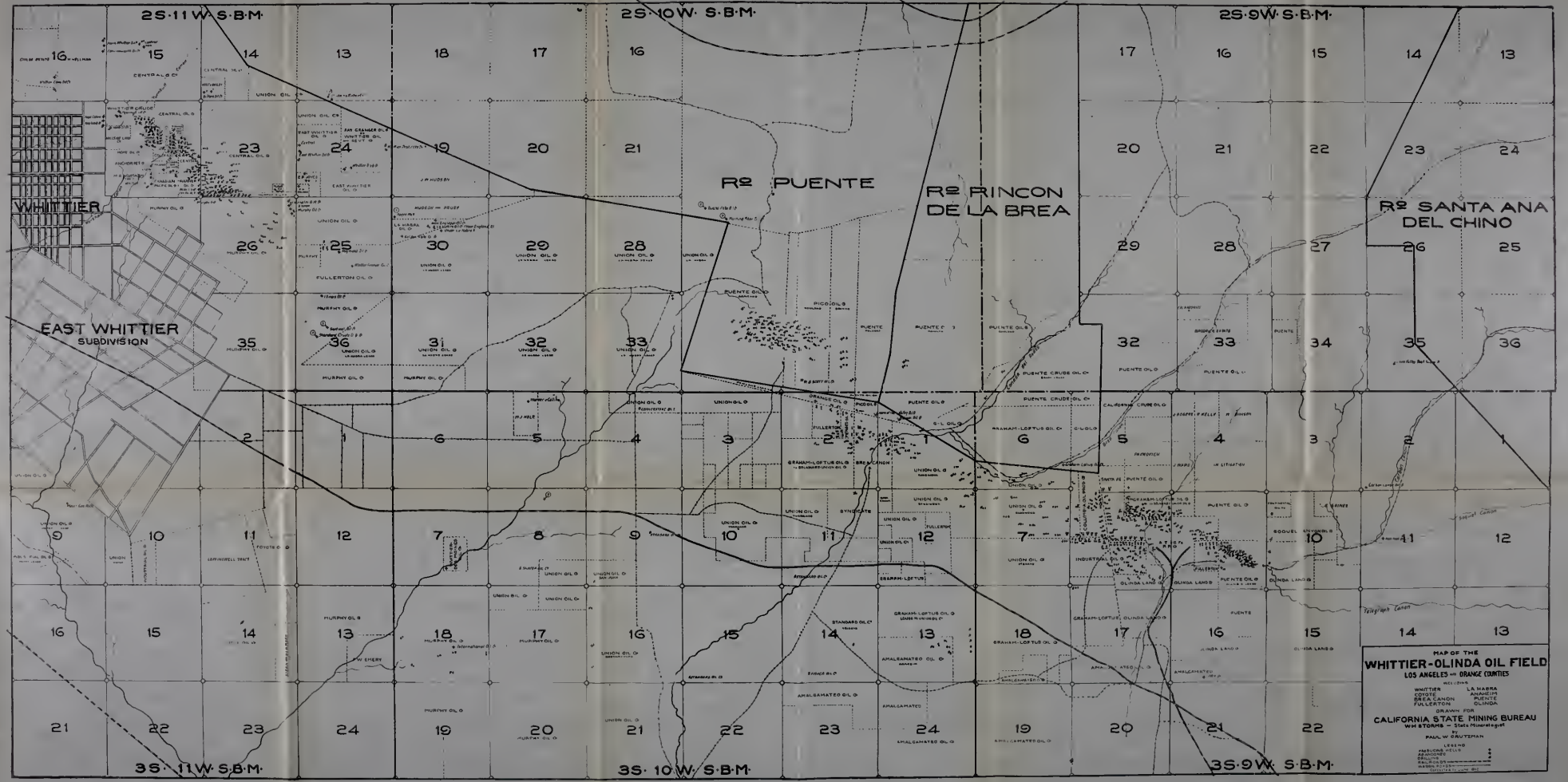
OTHER MAPS.

California, Showing Mineral Deposits—		
Mounted	$1.50	$.20
Unmounted	.30	.15
Forest Reserves in California—		
Mounted	.50	.08
Unmounted	.30	.06
Mineral and Relief Map of California	.25	.05
El Dorado County, Showing Boundaries of National Forests	.20	.02
Madera County, Showing Boundaries of National Forests	.20	.02
Placer County, Showing Boundaries of National Forests	.20	.02
Shasta County, Showing Boundaries of National Forests	.20	.02
Sierra County, Showing Boundaries of National Forests	.20	.02
Siskiyou County, Showing Boundaries of National Forests	.20	.02
Trinity County, Showing Boundaries of National Forests	.45	.02
Tuolumne County, Showing Boundaries of National Forests	.20	.02
Mother Lode Region	.05	.02
Desert Region of Southern California	.10	.02
Minaret District, Madera County	.20	.02
Copper Deposits in California	.10	.02

MAP OF THE
SANTA MARIA OIL FIELD
SANTA BARBARA CO.
INCLUDING
SANTA MARIA = OLD FIELD
CAT CANON = EAST FIELD
LOMPOC = SOUTH FIELD
DRAWN FOR
CALIFORNIA STATE MINING BUREAU
W.H. STORMS - State Mineralogist
BY
PAUL W PRUTZMAN
LEGEND
PRODUCING WELLS
ABANDONED "
DRILLING "
RAILROADS
WAGON ROADS
corrected to June 1918
RANCHO LOS ALAMOS
Rᵉ SISQUOC
Rᵉ TINAQUAIC
Rᵉ TODOS SANTOS
Rᵉ LA LAGUNA
Rᵉ MISSION DE LA PURISIMA
Rᵉ SANTA RITA
Rᵉ SAN CARLOS DE JONATA
Rᵉ CORRAL DE QUATE
UNION OIL CO ARRELLANES TRACT
UNION OIL CO HARTNELL TRACT
NEWLOVE OIL CO NEWLOVE TRACT
ASSOCIATED OIL CO ESCOLLE TRACT
ASSOCIATED OIL CO NEWHALL TRACT
LAS FLORES LAND AND OIL CO
UNION OIL CO TERESA BELT
REFINING - PRODUCING OIL CO
HARRIS TRACT
WESTERN UNION OIL CO
R.F. CARREAGA TRACT
JOHN BELL TRACT
JUAN B CARREAGA TRACT
ESPERANZA CONS OIL CO
ESTATE - GASPAR ORENA
UNION OIL CO PURISIMA TRACT
UNION OIL CO HILL TRACT
LOS ALAMOS
TOWNSHIP 8 N 32 W S.B.M.
TOWNSHIP 8 N 33 W S.B.M.
TOWNSHIP 8 N 34 W S.B.M.
TOWNSHIP 7 NORTH 33 WEST
TOWNSHIP 7N 32 W S.B.M.

RANCHO LA LIEBRE
RANCHO SAN FRANCISQUITO
RANCHO SAN PASQUALE
RANCHO SANTA ANITA
RANCHO EX-MISSION DE SAN FERNANDO
RANCHO TUJUNGA
RANCHO EL ENCINO
RANCHO LAS VIRGINES
RANCHO SAN VICENTE Y SANTA MONICA
RANCHO SAN JOSE (SAN DIMAS ADDITION)
RANCHO AZUSA DE DALTON
RANCHO AZUSA DE DUARTE
RANCHO LA CANADA
RANCHO LA ZANJA
RANCHO PROVIDENCIA
RANCHO SAN FRANCISCO
RANCHO EL CONEJO
RANCHO SIMI
GERMAN STATION
SEEPE
MODELO
HOPPER
EUREKA
TAPO
TORREY
PICO
PLACERITA
ELSMERE
WILEY
SAUGUS
CASTAIC
FERNANDO
PACOIMA
SANTA SUSANA
CANOGA
CALABASAS
RESNICK
CHATSWORTH
DUNNIGAN
MOSCOW
ROCKCASTLE
SUNLAND
TUJUNGA CANYON
TUJUNGA CREEK
LA CRESCENTA
MONTROSE
GLENDALE
PASADENA
SIERRA MADRE
MONROVIA
ARCADIA
AZUSA
GLENDORA
COVINA
CHARTER OAK
SAN DIMAS
LA VERNE
CLAREMONT
POMONA
CUCAMONGA
ACTON
SOLEDAD CANYON
SANTA CLARITA
NEWHALL
SAUGUS
CASTAIC
HOLLYWOOD
SANTA MONICA
SAN FERNANDO
SAN GABRIEL
SAN BERNARDINO BASE LINE
MANZANA
FAIRMONT
SUNSET
VENTURA
SANTA BARBARA
LOS ANGELES
ORANGE
RIVERSIDE
SAN BERNARDINO

MAP OF
SOUTHERN CALIFORNIA
WITHIN THE BOUNDS OF THE PRODUCING OIL FIELDS - NEWHALL, VENTURA, WHITTIER-OLINDA, LOS ANGELES AND SALT LAKE, ONLY A PORTION OF THE WELLS ARE SHOWN. CONSULT LARGE SCALE MAPS FOR DETAILS. OUTSIDE THESE BOUNDS, ALL KNOWN WELLS ARE LOCATED AND NAMED.
DRAWN FOR
CALIFORNIA STATE MINING BUREAU
W.H. STORMS ~ State Mineralogist
by
PAUL W. PRUTZMAN
LEGEND
PRODUCING WELLS
ABANDONED "
DRILLING "
RAILROADS
WAGON ROADS
Corrected to June-1912
152 PAUL W. PRUTZMAN
CITY OF LOS ANGELES
SANTA MONICA
OCEAN PARK
REDONDO
SAN PEDRO
WILMINGTON
LONG BEACH
HOLLYWOOD
SALT LAKE
WHITTIER
PUENTE
FULLERTON
OLINDA
BREA CANON
COYOTE
ANAHEIM
SANTA ANA
HUNTINGTON BEACH
NEWPORT
POMONA
ONTARIO
CHINO
MONROVIA
SAN JUAN CAPISTRANO
TOPANGA
RANCHO SAN JOAQUIN
RANCHO LOS ALAMITOS


2S·11W·S.B.M.
2S·10W·S.B.M.
2S·9W·S.B.M.
Rº PUENTE
Rº RINCON DE LA BREA
Rº SANTA ANA DEL CHINO
WHITTIER
EAST WHITTIER SUBDIVISION
3S·11W·S.B.M.
3S·10W·S.B.M.
3S·9W·S.B.M.
MAP OF THE
WHITTIER-OLINDA OIL FIELD
LOS ANGELES and ORANGE COUNTIES
INCLUDING
WHITTIER
COYOTE
BREA CANON
FULLERTON
LA HABRA
ANAHEIM
PUENTE
OLINDA
DRAWN FOR
CALIFORNIA STATE MINING BUREAU
WM STORMS — State Mineralogist
BY
PAUL W. GRUTZMAN
LEGEND

MAP OF SANTA BARBARA COUNTY CALIFORNIA

DRAWN FOR

CALIFORNIA STATE MINING BUREAU

W.H. STORMS – State Mineralogist

by

PAUL W. PRUTZMAN

LEGEND

PRODUCING WELLS ..... •

ABANDONED " ..... •

DRILLING " ..... •

RAILROADS

WAGON ROADS

Corrected to June 1912

BOUNDS OF SANTA MARIA, CAT CANON AND LOMPOC MAP

INDEX

1 - Hulholland Oil Co.
2 - Traders Union Oil Co.
3 - Syndicate Petroleum
4 - The Oil Co.
5 - A.G.Co. Arrelenes
6 - Casmalia Ranch #3
7 - Casmalia Petroleum
8 - Kern Trading & Oil Co.
9 - Casmalia Ranch 1 & 2
10 - Anglo-Cal.Oil Synd.
11 - Bear Creek O.& D.Co.
12 - Jalama Oil & Devl.Co.
13 - Las Cruces Oil Co.
14 - Miesels Oil Co.
15 - Rush,Hoff & Lombard
16 - S.Barbara-Cal. 1 & 2
17 - " #3
18 - San Lucas Oil Co.
19 - Sapphire Oil Co.
20 - Weisendanger #1
21 - Weisendanger #2
22 - S.B.& Naples #1
23 - " #2
24 - " #3
25 - F.Churchill #1
26 - " #2
27 - Associated Oil Co.
28 - Steele & Thompson
29 - Mescalitan Island Pet
30 - Arroyo Burro well
31 - Drexel Oil Co.
32 - Veas Development Co.
33 - Sycamore Canon Oil Co
34 - Crescent Oil Co.
35 - Churchill & Weber
36 - J.K.Fisher
37 - Clark,Stevens & Duncan
38 - J.R.Treadwell
39 - Occidental O.W.& P.Co
40 - Carpinteria Oil Co.#1
41 - Carpinteria Oil Co. #2
42 - Santa Monica Oil Co..
43 - Columbian O.A.&R.#1
44 - Columbian refinery
45 - Nixon & Bosig #1
46 - Bituminous Rock quarry
47 - Nixon & Bosig #2
48 - Rahn Consolidated O.Co.
49 - P.C.Higgine shaft
50 - Columbian O.A.& R.#2
51 -
52 - P.C.Higgine well
53 - Arctis Oil Co.
54 - R.W.Hill
55 - J.Heath
56 - Churchill Bros. #1
57 - Southern Cons.Oil Co.
58 - Churchill Bros.#2
59 - Denton Oil Co.
60 - Rincon Oil Co.

T.5N.23W.
T.5N.22W.
T.5N.21W.
T.5N.20W.
T.4N.21W.
T.4N.20W.
T.3N.23W.
T.3N.22W.
T.3N.21W.
T.3N.20W.
RANCHO OJAI
4-23
RANCHO OJAI
4-22
RO OJAI
RANCHO SANTA ANA
RANCHO EX-MISSION
RANCHO EX-MISSION DE SAN BUENAVENTURA
Rª CANADA LARGA
RANCHO EX-MISSION
SESPE TRACT 2
SESPE TRACT 2
SESPE TRACT 1
RANCHO SIMI
RO LAS POSAS
FILLMORE
SESPE
HARDHOFF

MAP OF THE

VENTURA - NEWHALL OIL DISTRICT

LOS ANGELES AND VENTURA COUNTIES

IN VENTURA COUNTY

NORDHOFF - OJAI - SILVERTHREAD - SULPHUR MOUNTAIN - E. MISSION - SANTA PAULA - SAN CAYETANO - BIG SESPE - TAR CREEK - LITTLE SESPE - FILLMORE - HOPPER - PIRU - BARDSDALE - EUREKA - TORREY - TAPO - SIMI

IN LOS ANGELES COUNTY

CASTAIC - PICO - DEWITT - WILEY - RICE - EAST - ELSMERE - NEWHALL - PLACERITA

CALIFORNIA STATE MINING BUREAU

W. H. STORMS ~ State Mineralogist

BY

PAUL W. PRUTZMAN

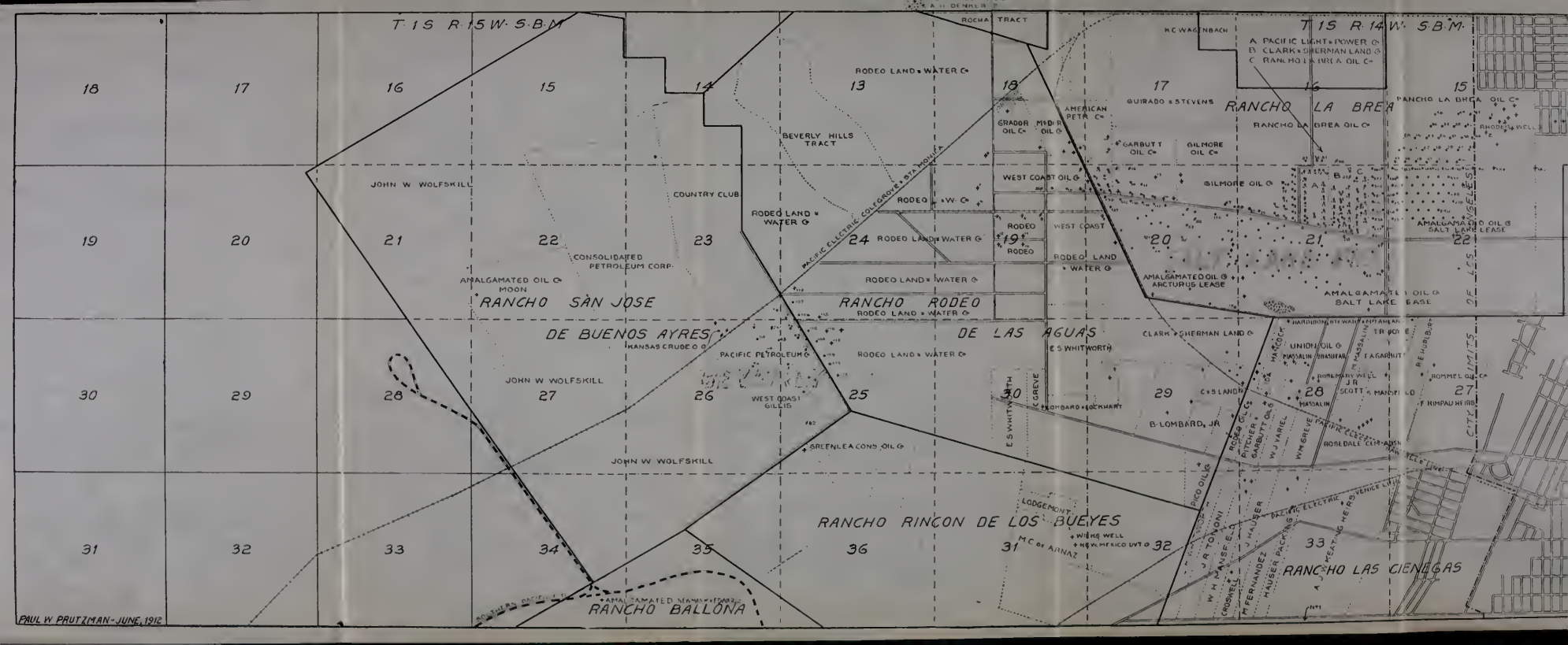
LEGEND

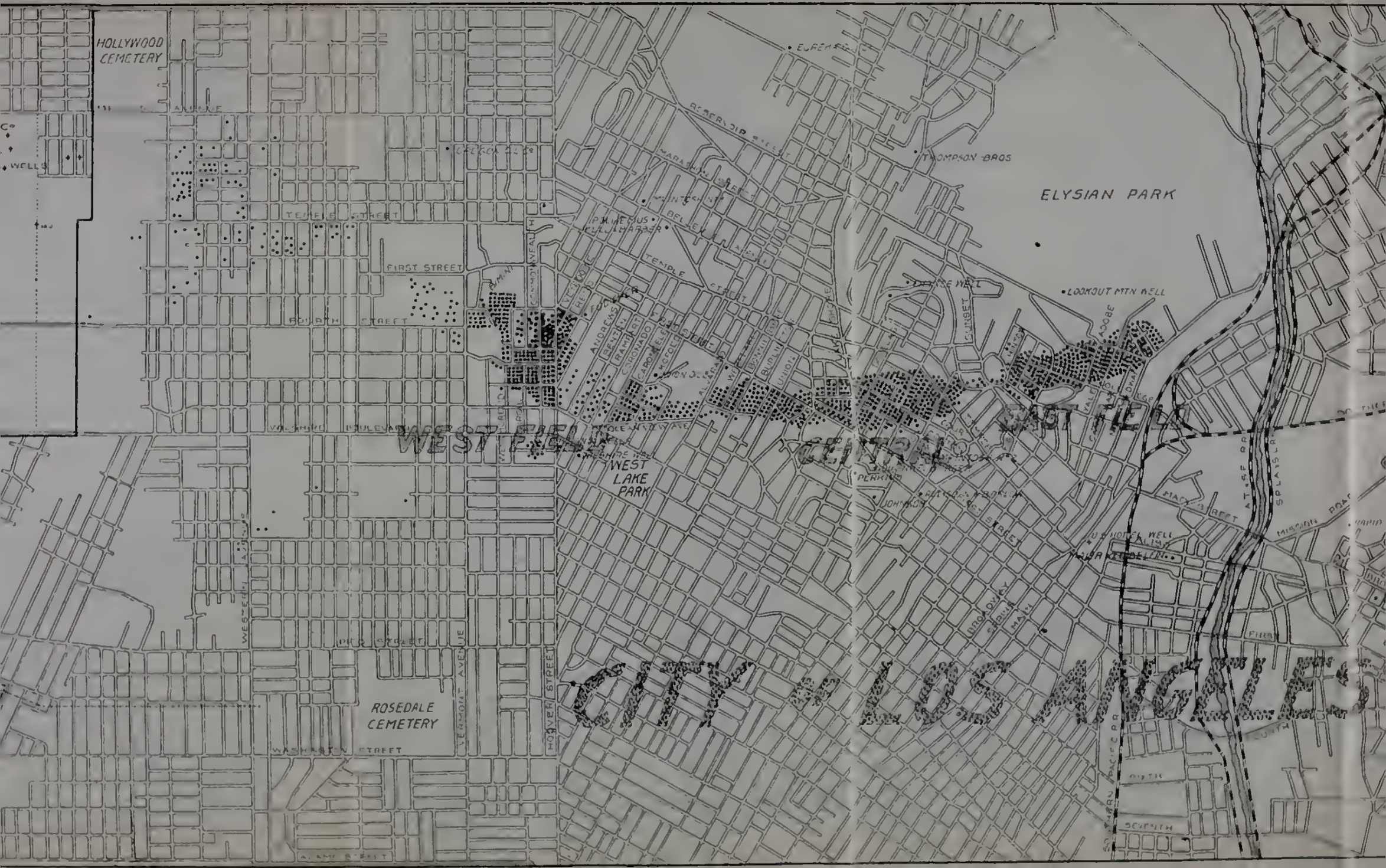
PRODUCING WELLS
ABANDONED "
DRILLING "
RAILROADS
WAGON ROADS

Corrected to June 1912

TP. 5 N. 19 W.
TP. 5 N. 18 W.
TP. 5 N. 17 W.
TP. 5 N. 16 W.
TP. 4 N. 19 W.
TP. 4 N. 18 W.
TP. 4 N. 17 W.
TP. 4 N. 16 W.
TP. 4 N. 15 W.
TP. 3 N. 19 W.
TP. 3 N. 18 W.
TP. 3 N. 17 W.
TP. 3 N. 16 W.
TP. 3 N. 15 W.

RANCHO TEMESCAL
CASTAIC
RANCHO SAN FRANCISCO
RANCHO SIMI
RANCHO EX-MISSION DE SAN FERNANDO
NEWHALL
SESPE TRACT 2


T 1 S R 15 W S B M
T 1 S R 14 W S B M
RANCHO SAN JOSE
RANCHO RODEO
DE BUENOS AYRES
DE LAS AGUAS
RANCHO RINCON DE LOS BUEYES
RANCHO LA BREA
RANCHO LAS CIENEGAS
RANCHO BALLONA
ROCHA TRACT
BEVERLY HILLS TRACT
COUNTRY CLUB
CONSOLIDATED PETROLEUM CORP.
JOHN W WOLFSKILL
RODEO LAND & WATER Co
AMALGAMATED OIL Co
MOON
KANSAS CRUDE Co
PACIFIC PETROLEUM Co
WEST COAST OIL Co
WEST COAST
RODEO
GILMORE OIL Co
GARBUTT OIL Co
AMERICAN PETR Co
GRADOR MADIR OIL Co
GUIRADO & STEVENS
RANCHO LA BREA OIL Co
PANCHO LA BREA OIL Co
AMALGAMATED OIL Co ARCTURUS LEASE
AMALGAMATED OIL Co SALT LAKE LEASE
CLARK & SHERMAN LAND Co
E S WHITWORTH
UNION OIL Co
MASSALIN
TAGARUT
SCOTT & MANSFIELD
B LOMBARD JR
GREENLEA CONS OIL Co
LODGEMONT
WILKES WELL
NEW MEXICO LIVT Co
M C DE ARNAZ
PACIFIC ELECTRIC COLEGROVE & STA MONICA
PACIFIC ELECTRIC VENICE LINE
SOUTHERN PACIFIC R.R.
CITY LIMITS OF LOS ANGELES
PAUL W. PRUTZMAN - JUNE, 1912


HOLLYWOOD CEMETERY
WELL 3
TEMPLE STREET
FIRST STREET
BOYLE AVENUE
COMMONWEALTH
RESERVOIR STREET
THOMPSON BROS
ELYSIAN PARK
PHILLIPS HARBER
BELLEVUE
TEMPLE
LOOKOUT MTN WELL
SUNSET
ADOBE
ANDREWS
GLENDON
RAMIREZ
CORONADO
CARONDELET
VOLTAIRE
UNION
BURLINGTON
WESTLAKE
WEST LAKE PARK
VALENCIA BOULEVARD
PERSHING
JOHNSON
MACY STREET
AT&SF RR
SPLAINS LANDING
MISSION ROAD
WESTERN AVENUE
OLIVE STREET
VERMONT AVENUE
HOOVER STREET
ROSEDALE CEMETERY
WASHINGTON STREET
BROADWAY
MAIN
FIRST
SOUTHERN PACIFIC RR
SIXTH
SEVENTH
ALAMEDA STREET

TN
24
C2A25
no.63

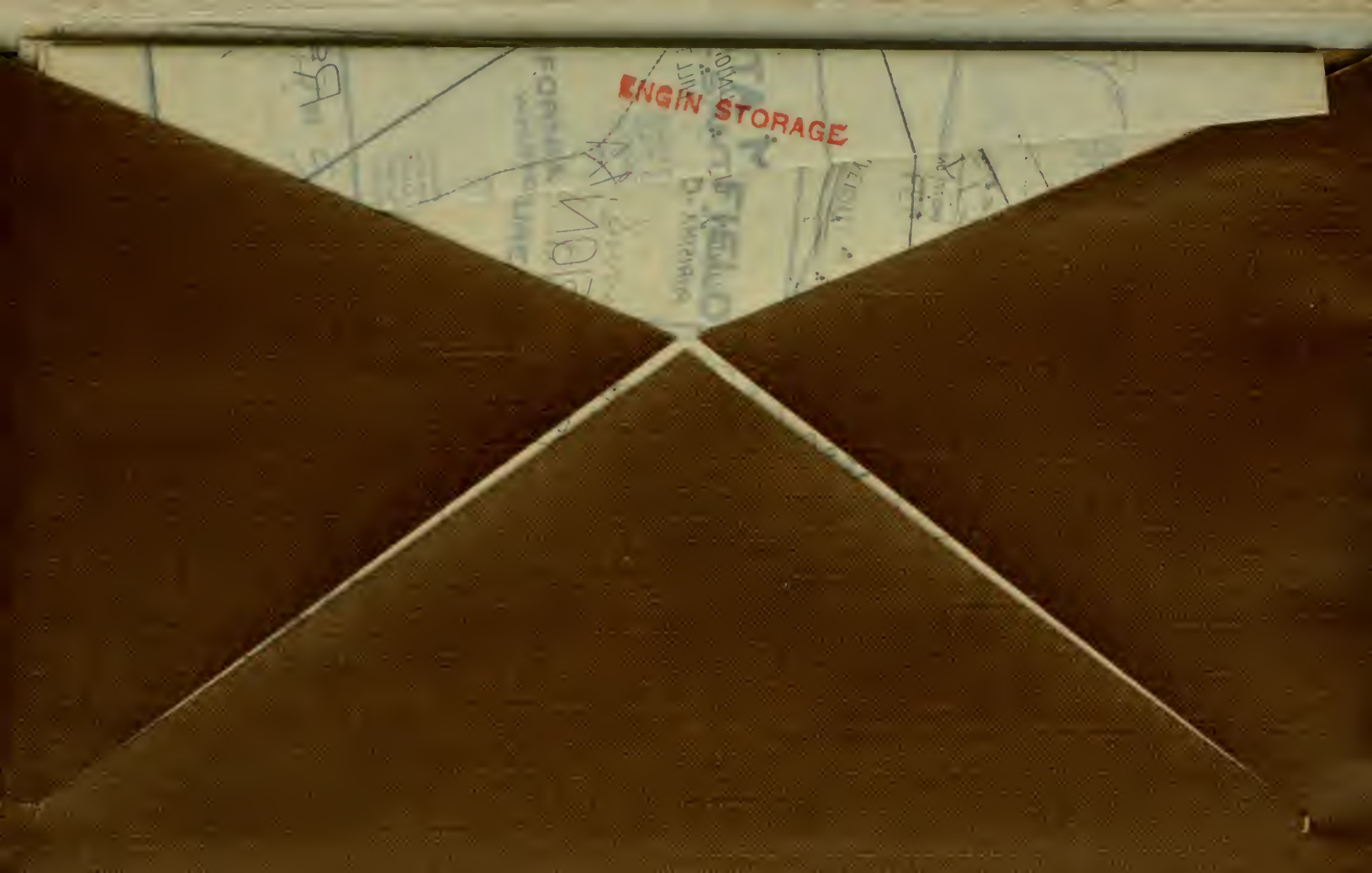
California. Division of Mines and Geology
Bulletin

Engineering

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

ENGIN STORAGE


ENGIN STORAGE